NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 40. Vol. VI. JUNE, 1895.

NOTES AND COMMENTS.

The Royal Society's Selection.

THE following candidates have been selected by the Council of the Royal Society for election as Fellows :—Mr. J. Wolfe Barry, Professor A. G. Bourne, Mr. G. H. Bryan, Mr. J. Eliot, Professor J. R. Green, Mr. E. H. Griffiths, Mr. C. T. Heycock, Professor S. J. Hickson, Major H. C. L. Holden, Mr. F. C. M'Lean, Professor W. MacEwen, Dr. S. Martin, Professor G. M. Minchin, Mr. W. H. Power, Professor T. Purdie. We have neither the intention nor the desire to join the protestations of a certain disaffected set who take an annual opportunity of cavilling at the selected list. We believe all the candidates to be worthy of their places, and we offer them our sincere congratulations. Last year, in noticing the list, we said :—"It is not likely that anyone whose opinion is worth having will cavil at this year's selection. Still we cannot help regretting that no geologist has been nominated." The fact that this year again zoologists, botanists, physiologists, medical men, engineers, chemists, physicists, and mathematicians have found a place, while geology is unnoticed, deserves more than a passing mention. There are geologists and to spare in England ; indeed, geology for long has been a characteristically English branch of science, and, in our opinion, its English exponents are as numerous and as ardent as ever they have been. The Royal Society's annual list may be taken as a fair index of the estimation in which the exponents of each science are held by the exponents of all the sciences. It is plain that either the exponents of geology already in the Royal Society, and especially on its Council, or the exponents of geology outside the Royal Society, are behind the exponents of other sciences in convincing scientific men of the relative claims of geology. It is for geologists to search out the reason and to set their house in order.

The Harveian Oration.

Dr. Lauder Brunton has recently published his oration for 1894. Taking as his subject the modern developments of Harvey's

work, he has succeeded in transforming what tends to be a perfunctory restatement of the obvious into a living account of the progress of science. Into the medical details, into the advances made in the treatment of disease, we do not propose to enter; we would merely point out a curious recurrence to the position of Harvey. The advance of science exhibits in a marked degree what Hegel called the dialectic of philosophy. In the history of knowledge, any two successive phases appear contradictory to each other; but the third phase is the reconciliation of contradictories in a higher unit.

When Harvey discovered the circulation of the blood, men's minds were receptive of vitalistic interpretations of nature. The harmonious unity of the animal body, for instance, they did not hold as a theory, but accepted with a childlike faith. In the matter of the varying flow of blood "*ubi stimulus ibi affluxus*," "increased flow goes where it is wanted," seemed to them so natural and necessary, that they did not inquire into the reason of it.

When it was realised that the heart was a force-pump, and the vessels a closed system communicating with it, mechanical interpretations held the field, and with each discovery of accelerating and depressing nerves the mechanical conception became stronger and stronger. But now that the intrinsic nerve-supply of the system, the nerves from the brain, and the controlling vaso-motor system have been demonstrated, we have reached a point where the mechanical conception—apparently complete—breaks down. All the strings and wires of a perfect mechanism are known, but the system works, not as a perfect mechanism, but as a self-regulating, vital whole. "Ubi stimulus ibi affluxus" represents exactly the position of our knowledge of to-day; and it is a statement, not an explanation.

GEOLOGICAL LITERATURE.

WE congratulate the Geological Society on showing itself alive to the needs of the time, and entering the ranks of the bibliographers. We alluded some time ago to the valuable list of accessions to the library, issued every year by this society, and we then pointed out the special value of that list, in that it gave one the complete geological contents of every journal received, which knowledge was not to be obtained elsewhere in this country. The Geological Society has now dropped this mode of recording, and has issued, separately from its *Journal*, an octavo pamphlet, entitled "Geological Literature added to the Geological Society's Library during the Half-year ended December, 1894." In future, therefore, the list will be concurrent with the years, instead of with the sessions of the Society—a convenient change. The present instalment, which is sold at 2s., contains a four-page list of abbreviations of titles of periodical literature, a list of all geological papers contained in the literature received, arranged alphabetically under authors, and occupying thirty-four pages, and a "Subject Index" of twenty pages.

Until certain conditions are fulfilled, we cannot pretend to welcome this change; and we trust that those responsible will not regard us as undue cavillers if we venture on certain suggestions. Let us say that the abbreviations employed in the author-index are so good that any glossary of them is really unnecessary. The space would be better devoted to informing the Fellows, as heretofore, precisely what parts of the journals listed have been received. The omission of a separate list of maps received is also to be regretted, and must be due to some oversight. As for the author-index, we have always said, and shall ever continue to say, that the value of such a list depends on its completeness. We do not complain that the compilers have omitted to index the paper on "The Homes and Migrations of the Earliest known Forms of Animal Life," contributed by Dr. Hicks to our December number, although they have indexed a similar paper by Dr. Hicks from another periodical, and have not omitted other papers in our number. But we mean to say that a list of only those papers which have been received by the Geological Society is necessarily and admittedly incomplete as a list of geological literature, and is, therefore, of small value to the geological student. In all lists of this kind it is the out-of-the-way papers that one wants to discover, and these are the very ones absent from the present list. With the disappearance of Dagincourt's *Annuaire*, an opening is presented to the Geological Society of doing a piece of work of world-wide importance, and not merely one for the delectation of its own Fellows. We cannot altogether overlook the fact that the present list is disfigured by some ugly mistakes, not to be excused as misprints, which ought never to have been passed by the Council, or which might at least have been corrected on an erratum-slip. The names of contributors to the *Quarterly Journal* at all events might be spelled correctly.

Our chief objection to the subject-index is that it is not a subject-index at all, merely an index, and a very incomplete one, to the catch-words of the titles. We will only ask any worker, who is sufficiently interested, to look up his own subjects in this index and to see if he considers the references at all adequate. If a subject-index is to be made at all, it must be made properly, and with a due appreciation of the difficulty of the task. We have found the twenty pages here devoted to it useless as a guide, and have had to go through the author-index on our own account in order to complete and correct the so-called subject-index.

If these few suggestions be accepted by the Geological Society in the spirit in which they are proffered, we shall hope next year to be able to congratulate it, not merely on its intentions, but on its accomplishment of them.

The Earthquake at Laibach.

The recent Austrian earthquakes furnish an instructive commentary on an article we publish this month on "The After-Shocks

of Earthquakes," by Mr. C. Davison. The first great shock occurred on April 14, at 11.13 p.m. During the same night twenty-five shocks were felt at Laibach, and within the next three days at least forty more were observed, some of them strong, though not approaching the first in severity. From April 19, if we may trust the newspaper accounts, they became much less frequent, from two to four noticeable ones, besides a few weak tremors, generally occurring every day until the end of the month. After this, except for a severe shock on May 19, they do not seem to have attracted much attention, probably from their comparative slightness. Laibach forms the centre of one of the most interesting and most promising earthquake districts in Europe, and if some Austrian seismologist, with the energy of Professor Milne, would take the matter up, we should be provided in about as many years as it would require generations in England with the materials we need for the study of the growth of faults.

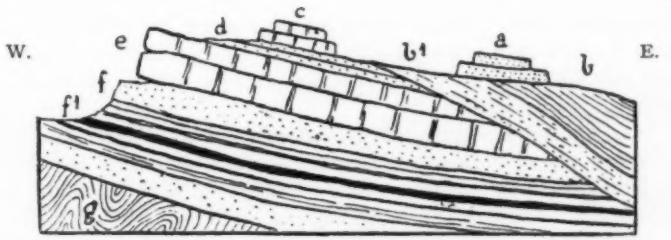
Artesian Water in Queensland.

Last December we commented on the excellent labours of the Geological Survey of Queensland, laying special emphasis on the intimacy that should exist between practice and pure science. Shortly afterwards an interesting address, enforcing the same moral, was sent us by the Government geologist, Mr. R. L. Jack; and now we have received from him a substantial proof of the truth of our remarks.

In our previous comment we alluded to the inquiries concerning an artesian or deep-seated water supply for the interior of Queensland. No great acquaintance with Australian physiography is needed for us to appreciate the enormous importance of such a supply. We have all heard of the terrible droughts in the interior of the continent, we know how the creeks dry up, and a glance at the map shows us how colonisation has hitherto been restricted almost to the sea-board. The soil in the western interior of Queensland is kindly, it supports grasses infinitely superior to those of the coast; and yet settlement is meagre, or impossible, because nearly all the rain falls on the belt of elevated country near the east coast, and only a half or a third as much reaches the western country. Though dams and tanks were constructed at a great cost, yet in 1885 cattle and sheep died by hundreds of thousands, and some of the western towns were threatened with extinction. Since then, on the recommendation of Mr. Jack, and Mr. J. B. Henderson, hydraulic engineer, over 200 bore-holes have been sunk along the western downs, which together have a daily yield of 125 million gallons. What this means may be understood by comparison with the daily public supply of London from all sources, which, as stated by the last Report of the Royal Commission, is about 171 million gallons. Last year further surveys and investigations were prosecuted by Messrs. Jack and A. G. Maitland,

and the preliminary results of their researches form *Bulletin No. 1 of the Geological Survey of Queensland.*

Somewhat remarkable explanations have been given to account for the occurrence of artesian water in Queensland. The populace imagines underground rivers, or reservoirs under great pressure in the bowels of the earth. The geological speculator pictures permeable beds passing beneath Queensland, and rising to the surface in the mountains of New Guinea. More profound philosophers have gone so far afield as the Himalayas or the Andes to find a collecting-ground for the Queensland water. The facts, for once, are not so strange as the fictions, and may readily be gathered from the accompanying diagram. On the right are seen the shales (b) of the Rolling Downs Formation, Lower Cretaceous in age; these stretch away to the east till they meet the sea, or are covered by the alluvial and other deposits near the coast. The lower part of the Rolling Downs Formation (b 1) is that which is of chief importance; it is called the Blythesdale Braystone, and consists of a series of soft, gray, very friable sandstones, grits and conglomerates, which absorb water with avidity. The outcrop of this rock forms a belt with an average width of five miles, and is estimated to present a gathering-ground for water of 5,000 square miles. These beds rest unconformably against a series of Triassic and Jurassic rocks, viz., the Darling Downs Basalt (c); Slates, Sandstones, and Coal-seams (d); Toowoomba Basalt (e); Murphy's Creek Sandstone (f); Ipswich Shales, Sandstones, and Coals (f 1). Below all come the folded Palæozoic Rocks (g). Above the Rolling Downs Formation lie patches of an Upper Cretaceous Rock, the Desert Sandstone, which once extended as a sheet over all the rocks just mentioned, but which is now found only in isolated patches, some of which obscure the outcrop of the Blythesdale Braystone.



GEOLOGICAL SECTION, WESTERN QUEENSLAND.—*R. L. Jack.*

There are a few water-bearing beds in the higher part of the Rolling Downs Formation; but for effective supplies the bores have to penetrate to the Blythesdale Braystone. This derives its water mainly from the annual rainfall of twenty-seven inches over its intake area. Much, also, is absorbed from numerous large streams

which cross its outcrop, but run for only a small portion of the year. The Desert Sandstone is also very absorbent, and where it "lies like a full sponge on the top. . . . of the Blythesdale Braystone, must tend to equalise the supply by feeding the latter long after the rivers have ceased to run." There is also evidence that the sandy beds d, f, and f^1 of the diagram may abut in places on the Blythesdale Braystone, and still further tend to equalise the supply. These auxiliary beds are of greater importance if it be the case, as some suppose, that the Blythesdale Braystone crops out on the sea-floor, and thus parts with some of its fresh water by leakage into the ocean. In any case it appears, from the figures collected by Mr. Jack, that the amount of water passing through this bibulous bed is far more than can ever be exhausted by artificial means, so that the multiplication of bores is not a danger to be dreaded, but a remedial measure to be urged on by all means. We hope that Queensland will support its Geological Survey, which has made its deserts blossom like the rose.

NIAGARA AND THE GREAT LAKES.

So much has been written on Niagara Gorge and the Great Lakes, without exhausting the subject, that we venture to bring before English geologists the conclusions arrived at by Mr. Frank Bursley Taylor, and published by him in *The American Journal of Science* for April. We reprint here merely his chronological conspectus, and must refer our readers to his paper for the details of the various steps, so concisely set down by him, and so easily followed by anyone who troubles to read the conspectus with a map in front of him.

Mr. Taylor says:—"At its maximum the great Laurentide glacier covered the whole area of the Great Lakes. By a correlation of the abandoned shore lines, moraines and outlets, and the gorges, recently submerged shore lines and rivers of this region, the following order of events is made out for the post-glacial history of the Great Lakes. They are set down in seven principal stages, with transitions or critical stages between.

"I. Glacial, ice-dammed lakes. Outlets at Fort Wayne, Chicago, and other places. Beaches correlated with moraines in Ohio. Glacial lakes fall by stages as outlets change on withdrawal of the glacier-dams. Land relatively high in the north but slowly subsiding.

"*First Transition:* By withdrawal of glacier the Niagara river is opened and the upper lakes become united.

"II. First Niagara lakes. First epoch of Niagara Falls begins at Lewiston. For a short time glacial Lake Iroquois receives the water from Niagara. Shore lines of lower levels of this glacial lake washed over and obliterated by later marine invasion. Gradual depression of land continues at north, finally opening Nipissing outlet.

"*Second Transition:* First two-outlet climax. Marked by the ALGONQUIN BEACH. (Possible subdivision here for supposed Trent river outlet.) Gradual northward depression continues. First epoch of Niagara Falls closes at the Whirlpool. Epoch of Erigan Fall begins.

"III. First Lake Algonquin. Outlet eastward over Nipissing pass.

"*Third Transition:* Gradual northward depression continues. Nipissing outlet brought down to sea level. Lakes become marine.

"IV. Warren Gulf (rising stage). Marine waters fill the three upper lakes, the Ontario, St. Lawrence and Winnipeg basins.

"*Fourth Transition:* Marine climax. Marked by the CHIPPEWA BEACH. Northward depression ceases and gradual elevation begins. Iroquois and Herman marine beaches made at the same time as the Chippewa. This was probably the climax of the post-glacial warm epoch.

"V. Warren Gulf (falling stage). Gradual northward elevation. Irregular uplifts in the north deforming Chippewa and Algonquin beaches.

"*Fifth Transition:* Nipissing outlet raised to sea level. Upper lakes become fresh.

"VI. Second Lake Algonquin. Outlet eastward over Nipissing pass. Probably a small amount of local uplift at outlet in early stage.

"*Sixth Transition:* Second two-outlet climax. Marked by the NIPISSING BEACH. Epoch of Erigan Fall closes at a point between 40 and 80 rods above the cantilever bridge. Second (present) epoch of Niagara Falls begins.

"VII. Second Niagara lakes (present stage). Lake Superior becomes independent. Great Champlain uplift at the north-east. Formation of St. Clair delta begins and continues to the present time."

PRIMÆVAL MAN.

LAST November we published a paper by Professor Rupert Jones on the discovery by Dr. Fritz Noetling of Flint Chips in the Upper Miocene of Burma. Dr. W. T. Blanford writes to our contemporary, *Nature*, that a letter received by him from Dr. Noetling states that the beds in question have since been definitely ascertained to be Pliocene and not Miocene. This, though it reduces the proved limits of man's antiquity, does not diminish the interest and importance of the discovery.

Some remarkable finds have recently been made in the loess of Predmost, in Moravia. Carbon, chipped flints, and bones of extinct animals were previously known, but it was not till May, 1894, that Mr. K. J. Maska, a well-known Czech archæologist, found remains definitely human. His researches have since been rewarded by the

discovery of ten almost complete skeletons, in the natural position as they had been buried in the brick-earth. The state of preservation of the bones, and the occurrence in their immediate neighbourhood of bones of the arctic fox and the mammoth, leave no doubt that they belonged to Quaternary man. We learn from *L'Anthropologie* that the remains are supposed to have belonged to a family, which, after having perished in some catastrophe or other, was interred in this place before the culture-layer found above had begun to form—that is to say, at the earliest period of habitation at Predmost. A block of stone was placed on the tomb to prevent the ravages of wild beasts, an end which was not completely attained, since some of the bones have been found at a little distance from the tomb and marked by the teeth of animals. The shape of the skulls shows that the Quaternary inhabitants of Predmost belonged to a dolichocephalic race, that their forehead was retreating, especially in the males, with strong superciliary ridges, and a snub nose. The superciliary ridges are, however, less developed than in the Neanderthal cranium.

The skeleton of a primitive man is said to have been found some years ago in the alluvial deposits of the lower Thames. We learn that the remains consist of a human skull and limb-bones found in the Palæolithic Terrace-gravel of Galley Hill, Greenhithe, Kent. Mr. E. T. Newton read an account of them before the Geological Society on May 22, after we had gone to press.

THE SHELLS OF THE ANTILLES.

THE West Indies may well be considered a paradise for the malacologist. Apart from the abundant marine fauna, their superficial area of 95,000 square miles supports some 1,600 species of terrestrial molluscs, or nearly as many as are found on the mainland of the entire continent of America. The distribution of these through the various islands of the group forms the theme of a valuable paper by Mr. C. T. Simpson (*Proc. U.S. Nat. Mus.*, vol. xvii.), who prefaces his remarks with a few words on the physical geology of the West Indies, and a lucid summary of the means of dispersal of non-marine mollusca. The tables of distribution themselves, dealing as they do with strings of names, are too technical for all save the very elect; but the details concerning the relationships of the faunas of the several groups of islands, both to one another and to the various adjacent portions of mainland, yield much interesting information. The conclusions arrived at concern the geologist quite as much as the malacologist. Briefly summed up, they are that "a considerable portion of the land-snail fauna of the Greater Antilles seems to be ancient, and to have developed on the islands where it is now found. There appears to be good evidence of a general elevation of the Greater Antillean region, probably some time during the Eocene, after most of the more important groups of snails had come into existence, at which time the larger islands were united, and there

was land connection with Central America by way of Jamaica and possibly across the Yucatan Channel, and there was then a considerable exchange of species between the two regions. At some time during this elevation there was probably a landway from Cuba across the Bahama Plateau to the Floridian area, over which certain groups of Antillean land-molluscs crossed. At this time it is likely that the more northern isles of the Lesser Antilles, which seem to be volcanoes of later Tertiary and Post Pliocene date, were not yet elevated above the sea or if so they have probably been submerged since. After the period of elevation then followed one of general subsidence. During this, the island of Jamaica . . . was first to be isolated, then Cuba, and afterwards Haiti and Puerto Rico were separated. The connection between the Antilles and the mainland was broken, and the Bahama region, if it had been previously elevated above the sea, was submerged; the subsidence continuing until only the summits of the mountains of the four Greater Antillean Islands remained above water. Then followed another period of elevation, which has lasted no doubt until the present time. . . . The Bahamas . . . have been peopled by forms drifted from Cuba and Haiti. . . . The Lesser Antilles have been peopled for the most part from South America."

Hanging Foliage.

In the latest issue of the *Annals of Botany* (March), the hanging foliage of certain tropical trees forms the subject of a paper by F. W. Keeble. It is well known that the young leaves and branches of several species of leguminous plants hang vertically downward in the early stages of their life, and the writer has been seeking the causes which have induced this habit. Stahl saw in the occurrence merely a means of protection of the young leaves from the force of the violent tropical rain, which, owing to the stillness of the atmosphere in the tropics, generally falls vertically. From certain experiments of his own he concluded that the pendulous position was not a protection of the tender foliage from the sun's rays, or from too great a loss of water in transpiration. Mr. Keeble, however, found that the alcohol extract from leaves of *Amherstia nobilis* which had been fixed in a horizontal position, was of a lighter green than that from leaves which hung vertically. Moreover, he found that the delicate miniature leaves of the same plant withered more rapidly than those more fully developed, under similar conditions of exposure. As the older full-grown leaves were also found to transpire much more rapidly than the young hanging leaves, it was inferred that the tougher, more leathery mature organs could bear with impunity a loss far greater than that which sufficed to damage the delicate younger ones. Hence it seems probable that the pendulous position has been assumed, in part at least, as a protection from injury by exposure to direct sunlight and also against excessive loss of water by transpiration; for the

young leaves transpire more rapidly when outspread than when hanging. As a brightly coloured cell-sap is often characteristic of young foliage in the tropics, it has been suggested that some protection might thereby be afforded against too strong thermal or chemical action of the sun's rays; and thermometric observations showed that the surface layers of the red leaf reflected more heat than those of the green, and conversely, that the green leaf absorbed more heat than the red. That is to say, the red colouring-matter acts as a screen by which the heating effect of the sun's rays is moderated. Another observer has recently shewn that it also is a powerful agent in protecting the leaf from too intense light.

We might suggest the common ash as a subject of investigation on the same lines. The opening leaves are tinged with a beautiful red from the sap contained in the hairs and outer cell-layers of the young leaves and leaf-stalks. Plunging in hot water at once extracts the dye, giving a brilliant crimson solution, with an acid reaction, becoming greenish when rendered alkaline with potash or soda. Not many years ago a tree grew ready to hand outside the window of the Botanical Laboratory at Cambridge.

Some criticism is passed on Stahl's view of the functions of the long tips of the leaves as means for running off water from the upper surface. It is pointed out that in trees of *Amherstia nobilis*, growing in the Peradeniya Botanical Gardens, the rather long tips consist of tissue that does not become so tough or leathery as the rest of the eaf, and while uninjured in the pendent position, these thin extremities are rapidly killed when the leaves rise up and expose themselves to the sun. Moreover, the tips, which were very long in the earlier stages, become, as the full green adult condition is assumed, less well marked. If the pointed end is a "drip-tip," why then is it better developed when it is useless?—for by the young leaf's position no rain falls directly on it, and water-drops splashed on it are at once rolled off by the hairs which are then present but which disappear with maturity.

In addition, however, to these temporary advantages, the author suggests an additional "permanent" advantage. Besides affording protection to the young foliage, the pendent habit enables the branch and petioles to wait in a safe position till the conditions of shade or sun, as far as these are governed by the arrangement of other branches, can, so to speak, be ascertained. Then on rising up, the branch with its leaves meets conditions more akin to those under which it must pass the rest of its existence than if it had grown out horizontally from the first. By means of the waiting and the rising up of the branch and the petiole, the shoot behaves like one of the leaflets—both are able to adjust themselves to a nicety to the prevailing conditions of sunlight. The two movements, those of the shoot with its leaf and of the leaflets, are compared to a coarse and fine adjustment.

A Primitive Lily.

In the same magazine Mr. Ridley describes as a new genus, with the suggestive name *Protolirion*, a saprophytic plant collected by himself in the Malay Peninsula. Mr. Groom gives a detailed account of its structure, and also discusses its affinities. "*Protolirion*," he says, "may be regarded as closely related to the archetype of the Liliaceæ, and connecting the modern Liliaceæ with the Triuridaceæ." This interesting little plant is only three inches high, devoid of chlorophyll, and consists merely of a slender underground rootstock from which rises a simple scape bearing scales, and ending in a few small flowers. As the embryo in the seed shows no differentiation, the evidence for its being a monocotyledon rests on the arrangement of the parts of the flower in threes and on the presence of the nectar-secreting glands in the dividing walls of the ovary, known as septal glands, which hitherto have been found only in the petaloid monocotyledons. On the principle that union of parts denotes a later stage in phylogeny as compared with the case where they are free, *Protolirion* will hardly do for a near relative of the ancestor of the lilies. For while the typical lily has sepals, petals, and stamens, quite free and situated below the ovary, its supposed progenitor has the two former series (perianth) attached at the base to the ovary wall, the three outer stamens are similarly inserted, the three inner rising from the bases of the inner segments of the perianth. The pistil is remarkable from the fact that the lower portion of the ovary is inferior and three-chambered, while above it separates into three distinct portions.

We are much inclined to doubt the connection between this plant and the ancestral lily. Its saprophytic habit, which, as Mr. Groom suggests, may account for the apocarpous condition of the upper part of the pistil (a point which has to be explained away somehow), may also be responsible for points on which he lays more stress.

A most commendable feature about the whole thing is the co-operation of the systematist and anatomist to put forward an account which tells us something of internal structure as well as the mere external diagnostic characters to which papers on systematic botany are too often restricted.

The Action of Light upon Bacteria.

Professor Marshall Ward is continuing his researches into the nature of the inhibitory action of light upon the growth of bacteria. In the *Philosophical Transactions* of the Royal Society (1895, p. 961) he describes and illustrates by photographs some of his more recent results. When a pure culture of *Bacillus anthracis* was grown on a glass plate, to which light was admitted only by the aperture of a stencil-letter, after 24 hours incubation the shape of the

letter was most clearly marked upon the plate. The bacteria had grown thickly where they were protected from the light. Where the light passed through the stencil-letter all growth was stopped. After a longer incubation, under the same conditions, a few colonies appeared over the illuminated area. For several reasons Professor Ward inferred that these colonies had grown from spores that in some way were protected from the light, possibly by being concealed behind other spores, as the layer of jelly was not thin enough to contain a set of spores only one deep.

In another set of experiments, conducted both with solar light and with electric light, the influence of the different rays of the spectrum was examined. It was found that there was no bactericidal action, at least in the case of *Bacillus anthracis* grown on agar-agar, in the red, orange, yellow, and true green parts of the spectrum. The action began near the line F and extended right on into the violet. All the blue-violet rays were effective to some extent, but the maximum action was about the line G.

For a variety of reasons into which we cannot enter here, Professor Ward concludes that the bactericidal action of these rays is a direct action upon the living protoplasm of the bacteria. Many other observers have shewn that light hinders the growth of other bacteria. It has been shewn to have such an effect upon the typhoid bacillus and upon several bacteria not associated with disease. Professor Ward found that the growth of several fungi and moulds was hindered by it and he is inclined to the view that the direct action of light hinders the growth of all living protoplasm.

We need not point out that Professor Ward's results, combined with the results of previous investigators, have an important bearing upon public health. It is unnecessary in these days to insist upon the necessity of sunlight, or at least of daylight in all parts of dwelling houses. But there is a minor although important issue raised. Especially in large towns the washer-woman and the private laundry are gradually being replaced by steam laundries, and we have grounds for saying that in the majority of the larger institutions the drying of linen is carried out by artificial heat in closed chambers. Care is usually taken to secure proper ventilation of these, but no care is taken to secure that light and especially direct sunlight has due access to them. The clothes that used to dry on the village green or in the private yard were thoroughly disinfected by the kindly rays of the sun. Clothes dried in a heated chamber are returned to their owners without having undergone this natural and harmless disinfecting process.

A NEW WORM.

WE have received an interesting excerpt from the *Proceedings* of the Academy of Natural Sciences of Philadelphia dealing with a new genus of the Discodrilidæ, which the author, Mr. J. P. Moore, terms

Pterodrilus. The family, it should be explained, was formerly referred to the leeches on account of the jaws and the suckers. It is familiar to most zoologists in this country by the genus *Branchiobdella*. The new genus shows, perhaps even more obviously than *Branchiobdella*, the justice of placing these worms among the Oligochæta and of removing them from the Hirudinea. As a matter of fact, the gulf between those two groups is not now by any means so great as it was when we were only acquainted with the anatomy of *Lumbricus* among earthworms. There are many worms now known, belonging to the family Eudrilidæ, in which the generative pores are single and median, and in which there is a reduction of the cœlom by the extraordinary development of perivisceral sacs surrounding certain of the generative organs; these to some extent bridge over the gulf which has hitherto lain between the leeches and the earthworms. *Pterodrilus* is chiefly remarkable for the paired processes upon the back, which clearly suggest gills. There are now quite a crowd of Oligochæta, which, contrary to the Cuvierian definition of the group, are gilled. *Dero* has been long known with its circlet of gills round the anus. Professor Bourne has lately made known the Indian Naid, *Chætobranchus*, in which there are paired processes of the body-wall, which contain blood-vessels, and in which also, in certain parts of the body, the setæ are implanted. More recently still, Mr. Beddard has described the Tubificid *Branchiura*, with retractile gills upon the posterior segments of the body, containing blood-vessels, and an extension of the body-cavity separated from the general body-cavity by a diaphragm. And, lastly, there is the genus *Alma*, as it was originally called, which Dr. Michaelsen has lately shown to be identical with *Siphonogaster*. This is a true earthworm, with retractile gills that can be withdrawn into pits upon the body. *Pterodrilus* has a series of paired outgrowths of the dorsal body-wall which suggest gills; but, as the author of the paper points out, they do not altogether fit in with what might be expected of a branchial organ, in that they have no blood-vessels; they have no internal cavity either, but are solid throughout.

In the male reproductive organs this little Discodrilid is curiously like the aquatic family Lumbriculidæ. There are, as in the last-mentioned family, two pairs of sperm-ducts, which open, however, into a common atrium; in the segment in front of this lies the single spermatheca. Although the terminal gland of the male ducts, which is often termed the atrium, is single in this as in other Discodrilids, it shows traces of division, and there are four male ducts. There are two species of the genus, which, like their European allies, are parasitic upon crayfishes (*Cambarus*); they are of minute size, hardly exceeding a millimetre in length. If there was any doubt about the systematic position of the Discodrilidæ after the researches of Voigt and the monograph of Vejdovsky, Mr. Moore's paper settles the matter—at least to our satisfaction.

MESENCHYME.

IN a recent valuable memoir published by the Royal Society (*Philosophical Transactions*, vol. clxxxvi., p. 163), Dr. Gadow gives the result of an elaborate investigation made by Miss Abbott and himself upon the evolution of the vertebral column in fishes. He takes occasion to dismiss Hertwig's theory of the mesenchyme as a "gratuitous hypothesis." While we are far from accepting it in the full sense of Dr. Hertwig, we are unable to agree to Dr. Gadow's casual dismissal of it. It seems to us that it is worth while to emphasise the double nature of the blasts between the epiblast and hypoblast. In Echinoderms and in *Amphioxus*, to take two examples, there is the clearest possible distinction between the amœboid wandering cells that form the blood and connective tissues and the invaginations that form the cœlom. In the higher vertebrates the cœlom is not formed as a series of invaginations, and thus the distinctive character of its mode of origin is lost. But still there seems to remain the distinction between the set of cells that form the true cœlomic system and the set of cells that form the skeletogenous layer and the blood system. The origin of the two is more difficult to distinguish, and we think that Dr. Gadow's paper is most valuable as clearing up the exact mode of origin of the skeletogenous layer. But the difference in behaviour of the cells of the skeletogenous layers and of the cœlomic cells is equally striking. We do not think that the mesenchyme is yet to be abandoned.

THE VERTEBRAL COLUMN OF FISHES.

EVEN after the most careful study of the paper, in the absence of the necessary specimens, it is not easy to follow Dr. Gadow's summary of his results. The protovertebræ of primitive mesodermal segments divide into two parts. One of these, called the myotome by Dr. Gadow, divides to form a myomere, or section of the trunk musculature, and a part of the cutis. The other part forms a sklerotome, which produces skleromeres or skeletal trunk segments. The sklerotome or skeletogenous centre of each protovertebra consists of a separate dorsal and ventral half. Each of these is a curved S-shaped piece. In subsequent growth the dorsal half of each sklerotome grows downwards and comes to lie behind the ventral half of the sklerotome in front of it. Similarly, the ventral half of each sklerotome grows upwards, and comes to lie in front of and below the dorsal half of the sklerotome behind it. The acting units of the body are formed by the union of the unequally numbered sklerotomic halves in such a way that the dorsal half lies behind and above the ventral half. From this mode of union it results that the myomere or segment of the general trunk-musculature of the body comes into relation, not with the skeletogenous element formed from the same protovertebra, but with a compound element formed from the dorsal

and ventral parts of the skeletogenous elements formed from two protovertebræ. This alteration of relations has been known for long, and is always referred to, as the resegmentation of the body, the teleological explanation being that the muscles must pull upon two vertebræ in order to make the whole segmented organism a physiological unit. But, according to Dr. Gadow, it takes place in a manner fundamentally different to what has been supposed. Each new or permanent skleromere is not formed by the vertical splitting of two successive sklerotomes, but is composed of the dorsal half of the posterior and the ventral half of the more anterior sklerotome.

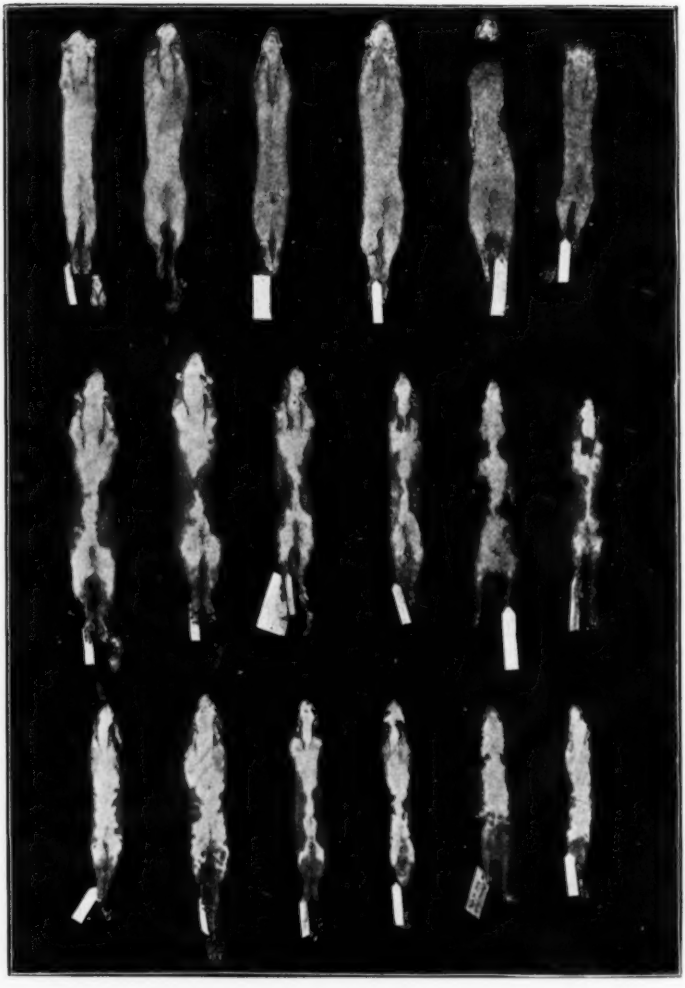
Apart from the interest of this for vertebrate morphology generally, it has a biological interest that may appeal to many naturalists who neither know nor care to know the details of the embryological history of the skeleton and musculature. For it is one of the many instances in which the doctrine of a sudden and inexplicable (save teleologically) change has been abandoned after minuter investigation for a doctrine of slow metamorphosis. It is almost impossible to believe, if one reflect upon it, that "resegmentation" actually could occur, that the primitive myotomes, having been formed, should be cut in two, and that the adjacent halves of successive myotomes should unite. But some such theory as that was accepted unquestionably for long, and, so far as we know, it has not been criticised before the appearance of this paper by Dr. Gadow.

A Monograph of Crinoids.

The crinoids of the Palæozoic rocks of North America are so rich and varied in form, so numerous in individuals, that they have long been the delight and the despair of naturalists. Especially is this the case with that order of the crinoids to which the name Camerata is now generally applied, the order that includes such well-known forms as the Nave Encrinite, *Actinocrinus*, the Rose Encrinite, *Rhodocrinus*, which are common enough in our own Mountain Limestone, together with the flatter and simpler form, *Platycrinus*. For, in America, there are added to these ordinary genera such remarkable creatures as the huge *Megistocrinus*, the speared and spined *Dorycrinus*, the peculiar mushroom-like *Agaricocrinus*, *Strotocrinus* like a college don in his mortar-board, *Eretmocrinus* with its broad oar-like arms, *Pterotocrinus* whose lofty dome is surmounted by wings, *Gilbertsocrinus* with strange drooping appendages of unknown function, and *Batocrinus* whose pores at the bases of the arms are equally mysterious. But this list does not include a quarter of the camerate or vaulted genera known from the Carboniferous rocks of America alone; while, if we accept the work of Mr. S. A. Miller and kindred spirits, the long line will stretch out to the crack of doom. Such, indeed, is the variety of form, and such the rashness of interpretation of some of the more enthusiastic collectors and describers, that to us European students the subject has become one

of inextricable complexity. It is, therefore, with peculiar pleasure that we learn that an authoritative monograph of these wonderful and beautiful beings is shortly to be issued.

Since the year 1859, or thereby, Charles Wachsmuth, who lives at Burlington, Iowa, in the very heart of the crinoid country, has devoted his life to the study of these animals. A large collection which he made was bought for the Museum at Cambridge, Mass., by Professor Louis Agassiz, at whose invitation Wachsmuth settled at the University to take charge of the whole collection of crinoids. The firstfruits of his study were published in 1877. After a time Wachsmuth returned to Burlington and began to form a second collection; much of this he was, unfortunately for himself, forced to part with, this time to the enrichment of the British Museum, in whose galleries some of his magnificent specimens are displayed. Association with Frank Springer enabled him to continue his collection and his studies, so that the series of fossil crinoidea made by the two friends is unrivalled even by the great collections of London, Harvard, or Stockholm, and their "Revision of the Palæozoic Crinoids" has long held the front rank among all works on the subject. In their knowledge of the writings of others, in their accurate discrimination of generic and specific characters, and in their important contributions to the morphology of the crinoids, these gentlemen have shown themselves most fitted to prepare that desired necessity, a monograph of the fossil crinoids of North America. The magnitude of the task, the failing health of the elder worker, and the business cares of the younger, have prevented the completion of more than a portion, that, namely, which deals with the Crinoidea Camerata. The text of this portion alone will fill between 600 and 700 quarto pages, while no less than eighty-three plates, of extreme beauty, have been drawn by A. M. Westergren, J. Ridgway, and C. R. Keyes, under the immediate supervision of the authors. It is fitting that Professor Alexander Agassiz and the Museum of Comparative Zoology at Harvard should undertake the publication of this monograph. It will appear as one of the Memoirs of the Museum, so soon as the plates can be photographically reproduced from the original pencil drawings—that is, it is hoped, early in 1896. The price will be thirty dollars. As the edition will be limited, intending subscribers are requested to send their names to Professor Agassiz at the earliest possible date. A work of such usefulness and importance needs no recommendation from us; we can only hope that the enterprise of the publishers and the devotion of the workers may meet with due appreciation from the scientific public, and that Charles Wachsmuth and Frank Springer may be spared many years of health and leisure, to place the crown on this worthy monument of American palæontology.



THE STOAT, THE ASSOGUE, AND THE WEASEL.

Photographed by Mr. A. Gepp, from specimens in the British Museum. The right-hand specimen in each row is a female; the rest are males.

I.

The Assogue (*Putorius hibernicus*): A Peculiar British Mammal.

ALTHOUGH several birds, recognised either as species or sub-species, are peculiar to the British Islands, no mammal has hitherto been considered sufficiently distinct from its Continental allies to deserve a peculiar name. Therefore, although notices of mere new species do not, as a rule, lie within the province of NATURAL SCIENCE, the recent discovery[1] that a well-known member of the Irish fauna represents a distinct species peculiar to that island seems worth a passing reference, especially as by the kindness of my colleague, Mr. A. Gepp, its characteristics can be so well illustrated as they are on the accompanying Plate iv.

This plate shows half a dozen specimens each of the Stoat, the Assogue, and the Weasel, those of the Irish animal being all that were available when the photograph was taken, and the others being picked at random from large series of each species, without any conscious selection to prove special points.

Briefly put, the differences between the three forms are as follows:

Stoat (*Putorius ermineus*).—Top row of plate.

> Size large; colour-distribution (in summer dress) perfectly constant; the light of the under surface covering the upper lips, the whole breadth of the throat, chest, and belly, and the inner sides of the limbs, and running on to the fingers and toes; line of demarcation between colours, straight and regular; rims of ears white; tail long black-tipped.

Assogue (*P. hibernicus*).—Middle row.

> Size medium; colour-distribution very variable, but the white always much reduced in extent, not extending on to the upper lip, narrowed, or even interrupted, on the chest and belly, and rarely extending on to the feet; line of demarcation between colours irregular; rims of ears brown; tail black-tipped.

[1] See Thomas and Barrett-Hamilton, *Ann. Mag. N. H.* (6), xv., p. 374, April, and *Zoologist* (3), xix., p. 124, 1895.

Weasel (*P. nivalis*).—Bottom row.

Size small; colour-distribution variable, but the white, as a rule, of less extent than in the Stoat, and of greater than in the Assogue; line of junction between the two colours irregular, as in the latter; rims of ears brown; tail short, uniformly brown.

It may be thought that these colour characteristics are of little importance, especially when it is granted that they vary in the Assogue; but the noticeable point is, that not a trace of variation, in these respects, can be found in Stoats elsewhere. Not less than some sixty or eighty specimens have been examined, coming from Scotland, England, and France on the west, through Scandinavia and Russia, to Siberia on the east, while even in those of Western North America, however other characters may differ, the colour distribution remains absolutely the same.

Compared to this vast area, that the little island of Erin, with a climate not unlike those of Cornwall or Brittany, and nearer to S.W. Scotland than we are to France, should have a local recognisable form is a most astonishing fact, and one for which it seems almost impossible to offer any reasonable explanation.

That, later on, we may find the Assogue to vary so as to meet the Stoat in colour, and, therefore, to be, according to some people, only a sub-species or "local race" of the latter, is, no doubt, possible; but this would, of course, be perfectly immaterial from the point of view of anything beyond mere species-naming, the fact remaining that the Stoat of Ireland is, even in its variability, an inherently different form from that found elsewhere. The discovery of the influences which have caused the one animal to become fixed in its colour-markings while the other has remained, or become, variable, is a nice problem which may be commended to the notice of geographical zoologists.

As yet, however, although the possibility is granted, no Assogue coloured like a Stoat has turned up out of more than a score of specimens seen; while the majority are of the very well-marked type represented by the five right-hand specimens in the figure.

I may take this opportunity of thanking the friends to whom we are indebted for specimens of this interesting animal, namely, Colonel J. W. Yerbury, Mr. J. E. Harting, Mr. Deane Drake, Mr. G. H. Pentland, and, most of all, Sir Douglas Brooke, from whom we have had nearly a dozen specimens. Lord Powerscourt, besides several dead examples, has also sent a pair of live ones, which may now be seen in the Small Cats' House in the Zoological Gardens.

Further specimens will still be acceptable, almost to any extent, as one of the most interesting points about the Assogue is its variability, and this can only be properly gauged when really considerable series are available for examination.

OLDFIELD THOMAS.

II.

The Cañons of Southern France.

THE great cañons of America are so well known that the very name of cañon has now an American flavour about it, and people are apt to forget that it is a Spanish word applicable to many valleys in Spain and in Southern France. Indeed, some remarkable examples occur in a part of France which it is now by no means difficult to reach, though it is only within the present century that Frenchmen themselves have become aware of the marvels to be found in a corner of their own country; and it is only by the recent extension of the Ligne du Midi, and by the conversion of ancient tracks into good roadways, that the "causses" and cañons of Lozère have been made accessible to the ordinary traveller.

Bounded on the north by the granite hills of central France, on the east by the range of the Cévennes, and rising high above the lowlands that border the Gulf of Lyons, are the "causses" of Lot and Lozère; high-lying plains or plateaux, consisting of thick Jurassic limestones disposed in nearly horizontal beds, and resting on clays and marls of Liassic age, from beneath which, to the north and east, emerge the gneiss and granite of the Central Highlands. Southwestwards, the causses descend in a series of broad steps toward the valley of the Garonne.

All the water which falls on the surface of the limestones is absorbed by those rocks and sinks into the ground, finding its way by subterranean passages and caverns down to the level of the springs, which feed the deep-sunk rivers of the country. The causses themselves are dry, rocky, and barren plains, without soil and without trees. But Mr. Baring-Gould[1] tells us that before the Revolution they were covered with forests, and that the impoverishment of the entire limestone district is due to the ruthless denudation which followed on that event. The seigneurial forests were cut down, the soil was bared to the winter storms, and, no longer held together by the roots of trees and shrubs, it was rapidly swept away and carried down into the depths of the valleys or into the swallow-holes, which gape like gigantic wells in the bare surface of the causses. "One hundred years has sufficed to sweep every particle of soil from

[1] "The Deserts of Southern France." Methuen & Co., 1894.

the causses, which it took countless ages to accumulate, and land that once maintained a well-to-do population is reduced to a desert."

"Swept by the cold winds of winter and parched by the heats of summer, only a Caussenard," says Reclus, "can love the causses, but every citizen of the world can admire the gorges of mighty depth that cleave it, and the precipices that form the walls of this gigantic acropolis. In decending by goat paths these bordering precipices, one is suddenly transported from parched wastes to pleasant pastures, from vast horizons, vague in outline and sad in tone, to smiling nooks of blended Heaven and earth . . . The startling contrasts between some of the cañons and their causses form one of the most phenomenal beauties of beautiful France."

But the pleasant pastures are generally very small, and the smiling nooks are often perched on steep slopes or on a narrow ledge above the rushing river. One or two of these gorges are indeed wide enough to admit of river, road, and rail; but most of them are in places so narrow that the river washes precipitous cliffs on each side.

It is these deep ravines or cañons, with their vertical walls, rising sometimes in a single sheer, continuous cliff, sometimes in a series of steps, with mural scarps and faces, that are the distinctive feature of the causses country. The tableland is divided by them into a number of isolated masses, and it is impossible to pass from one causse to another without descending into the depths of the cañon, and climbing again up the opposite cliff; there is no way round, for the river enters the cañon between limestone walls, and completely traverses the limestone region.

The average depth of these chasms is from 1,300 to 1,500 feet, and their width at the bottom varies from 160 to 1,500 feet. Their rocky walls are carved by rain and frost into an infinite variety of buttresses and turrets, alcoves and recesses, which recall the fantastic conceptions of Gustave Doré. Still, there is nothing monotonous or sombre about the scenery of the cañons, for though in places their precipitous sides close in till there is only just room for the river to pass, yet soon they widen out again and give space for fields and vineyards and orchards.

The finest of the cañons is that of the Tarn. "The whole of its course," writes Mr. Baring-Gould, "from Ispagnac to Roziers, a distance of thirty miles, is one succession of marvels. At every turn comes a surprise. The forms of the rocks are not alone singular and beautiful, the colouring is rich as it is surprising. The dolomitic limestone, which rises in nakedness to the height of 600 feet and even 1,800 feet on each side of the water is tinged and splashed with colour. It is fawn or salmon colour, with patches of red ochre, here stained black, there it gleams white. Everywhere it is sprinkled with the green of the box and the juniper clinging to the interstices. Overhead gleams down the azure sky and below flashes the foaming river." (*Op. cit.*, p. 80.)

Readers who wish for further particulars about this curious country will find excellent descriptions in the readable book by Mr. Baring-Gould; and so far as its physical features are concerned, in E. A. Martel's marvellously cheap and beautifully illustrated volume on the Cévennes.[2] My present intention is to discuss a point on which both these writers seem to be behind the knowledge of the day —namely, the manner in which these wonderful ravines have been formed.

Mr. Martel argues, and Mr. Gould takes it for granted, that the cañons were originally subterranean watercourses, and that the caverns formed by these underground waters became open valleys by the falling in of their roofs. This idea has commended itself to other travellers, and is even shared by some who have a considerable knowledge of geological causes. It is a possible explanation, and looking to the cañons alone, without considering the valleys beyond and below them, it might seem a reasonable way of accounting for their existence; but it is not the way in which other gorges and cañons have been formed, and there is no reason that I can learn why these should have been formed in so exceptional a manner.

A few decades ago it was generally supposed that such deep ravines were simply cracks in the earth's crust, and travellers described them as resulting from some "great convulsion of nature," laying stress on the fact that every concavity on one side was opposed by a convexity or promontory on the other, and taking it for granted that the two walls had originally fitted into one another and had simply gaped apart. Now we believe that a river is not there because of the valley, but the valley is there because of the river, which has gradually cut and carved its way through the solid land, and has thus led to the formation of the valley.

Let us grant, therefore, that running water has made the cañons of Lozère; but did the water begin its work below, or did it cut its way down from the surface? That is the question at issue. Limestone formations are always full of fissures, caves, and caverns which have evidently been occupied and enlarged by subterranean streams. If the roof of such a cavern fell in, would it not present the features of a cañon? It is quite possible that it would, in many respects; but it is exceedingly unlikely that the roof of a deep-seated cavern should fall in completely for any great distance.

The cañons are in some places over 1,500 feet deep, and that of the Tarn is thirty miles long; and one would not expect the roof of a cavern of such a length and such a depth to fall in along the whole of its course. Again, the floor of the cañon is a continuous slope, while most of the caverns have very irregular floors, here descending with a vertical fall, there blocked by a barrier which forms a lake. The roof is as irregular as the floor, being sometimes low and some-

[2] "Les Cévennes," par E. A. Martel. Paris, 5th edition, 1894.

times hollowed into lofty domes. It would, therefore, be very unlikely for the roof of a cavern to fall in all at once.

But supposing it fell in piece by piece, how is it that the roofs of those which are now cañons should have disappeared so completely, while the roofs of the many other caverns which do exist in the limestone have hardly fallen in at all? It is true there are swallow-holes and *avens*, which are holes in the roofs of caverns lying 200 or 300 feet below the surface; but if this was the way in which open cañons began to be formed, one would expect to find them in all stages of formation—some lengths fallen in and some still roofed over—so that natural tunnels and arches should be frequent along some of the cañons. But this is not the case; no such tunnel or arch occurs in the course of any one of the rivers. The cañons are everywhere clean-cut, open ravines.

Again, the main rivers do not take their rise within the causses district; it is true that one or two streams spring out of caverns within that district, and that all are largely fed by such springs, but the three chief rivers, the Tarn, the Joute, and the Doubies, rise outside the limestone area and cut right through it, separating one causse or plateau from another. The cañons of these streams are, therefore, merely the continuations of the valleys which they have made for themselves in the gneiss and granite.

Finally, there is no necessity for imagining the previous existence of a cavern. The streams running off the older rocks would be quite capable of excavating these gorges by ordinary mechanical means if they were first set running over the surface of the limestone plain from a watershed at a higher level. That they did once run over this surface and carved out the channel which has become a cañon, few geologists would doubt. The causses most certainly did not always exist as an isolated limestone district; they are part of a great formation which extended over the whole of southern France, from the Bay of Biscay to the Maritime Alps, stretching completely over the heights of the Cévennes, and spreading northward for some distance up the slopes of the Central Highlands. Much of the limestone formation may have been removed before the rivers came into existence, but when the rivers began to cut their channels, the surface of the limestone plateau doubtless extended northward and eastward till it met the rising plane of the older rocks which form the Cévennes and the Central Highlands. At the present time, the highest parts of the causses hardly reach 4,000 feet above the sea, while the Cévennes rise in places to over 5,000 feet. Consequently, if the cañons did not exist, and if the space between the eastern escarpment of the causses and the peaks of the Cévennes were bridged, or rather filled up, with limestone, the watersheds would remain where they now are, and the streams would run over the surface of the limestone plateau.

So also with the rivers Lot, Dordogne, and Vesère, which traverse the causses of Guyenne. They rise in the highlands of Corrèze and

Cantal, and there was a time when they meandered over the surface of the limestone which is now so deeply trenched by their valleys.

Many people admit that ordinary valleys have been excavated by rain and rivers, but when they see a river passing between lofty walls of solid rock, they ask how liquid water can saw out such a passage. The geologist replies that a river in flood is not only water, it is full of sand and mud, and, moreover, it sweeps stones along the bottom of its channel. It is the silt, sand, and stones that erode; the stream is only the motive power which works and guides the machinery.

Still, it is objected that few rivers, either in England or on the Continent, seem to be deepening their channels at the present time, even when they are in flood. This is perfectly true. A river above the influence of the tides cannot sink its channel below the level of the sea, and, when it has cut its valley down to a certain slope, it ceases to have any power of deepening *so long as the land remains stationary*. If, however, the land is raised, the erosive power of the rivers is renewed. Upheaval increases the height through which the water has to fall before it reaches the sea, and enables the rivers to cut their way deeper into the land. Subsidence lessens the relative height of the land, and not only stops the deepening process, but causes the streams to deposit the materials they carry.

It is because geologists for a long time failed to perceive that the erosive power of a river is controlled and limited by the movements of the land that certain sceptics have refused to believe that valleys have been made by rivers alone. The anonymous author of a book entitled "Scepticism in Geology," referring to the rocky barrier known as the Iron Gate just below the great gorge of the Danube, remarks that 'geologists have failed to explain to us how water-erosion, having (as they assert) cut through cliffs 2,000 feet high, should have stopped short at this petty barrier-reef." The answer, I should think, is that the river had reached its base level of erosion when it had cut down through the 2,000 feet of rock, and it will never remove the Iron Gate unless that part of Europe is once more raised to a higher level above the sea than that at which it now stands. The rivers of Lozère are not now deepening their channels, because their work is done; but their present incapacity for erosion is no proof of their having been incapable of making the cañons during a period of upheaval.

Those who imagine that the gorges which trench these limestone districts have been formed by the enlargement of fissures or by the falling in of caverns, forget that they are only part of a river-channel and that this river-channel is part of a great system of drainage. They forget, too, that in other countries similar ravines have been cut through rocks in which caverns do not exist.

The fact that the main rivers of the causses have their ultimate sources beyond and outside the limits of the causses country is alone sufficient to point out the manner in which the cañons have been formed. This has not escaped the notice of some of the French

geologists, and I may conclude with an apt quotation from a recent French work on Earth-sculpture [3], the authors of which write as follows (p. 170) :—" The deep valleys of the causses would not have existed if their drainage basins had been limited to the permeable limestone areas. The rain-water would have sunk into the ground instead of forming rivers large enough to excavate such deep ravines. On the contrary, the watercourses formed on the impervious rocks . . . entered the permeable region with a sufficient volume to erode their channels . . . The rocks in the upper reaches of the valleys were crumbled and washed down by the action of the rain ; while the limestones which crown the causses, thanks to their permeability, escaped this detritive action. This is sufficient to explain the aspect of the region round Florac, where the Tarn and its affluents seem to penetrate the thickness of the plateau as if they passed through a wall " ; meaning, of course, that the outer wall of the plateau has been developed *pari passu* with the excavation of the valleys, and was not there when the streams commenced their work.

For the inception of this work we must look back to early Tertiary times (Eocene or Oligocene), when the country was being elevated after the great Cretaceous submergence and when the Cretaceous and Jurassic limestones formed an extensive plain sloping gently away from the central highlands of France. It was then that the drainage system of the central provinces was marked out ; the decomposition of the granites, gneisses, and lavas of Auvergne and Limousin supplied plenty of grit for erosive purposes, and the rivers, having once established their channels, slowly sawed their way down through the layers of limestone. The upward movement of the land, whether this was continuous or episodic, kept the machinery in action and enabled the rivers to eat deeper and deeper into the tracts which subsequently became, by isolation, the elevated plateaux or causses of modern times.

Such I conceive to be the history of the formation of these remarkable valleys, and all the other physical features of the region are really dependent on the gradual formation of these deep ravines. The caverns which open at various levels in their walls register stages in the process of erosion, for the highest caves mark the time when the water issued at that level ; but as the cañons were cut deeper and deeper the subterranean waters were drawn off at lower and lower levels, either deserting their former tunnels or deepening them in places into underground cañons. Mr. Martel has explored many of these gloomy corridors and found them open here and there into lofty halls curtained by a profusion of stalactitic ornaments, like the grottoes of Adelsberg and other well-known subterranean palaces.[4]

A. J. JUKES-BROWNE.

[3] " Les Formes du Terrain," par MM. de la Nóe et de Margerie. Paris, 1888.

[4] See " Les Abimes," reviewed in NATURAL SCIENCE, vol. vi., p. 131. Feb., 1895.

III.

Individual Variations.

IN a Note with the heading "Variation and Probability" in NATURAL SCIENCE (vol. vi., p. 217) it is said:—"There are two classes of variation," viz., "large or sports," and "numerous small variations." . . . "Have species come from the large or from the small variations?" I am inclined to answer—rarely from either or chiefly from neither. Mr. Wallace expresses himself somewhat differently, for he says[1]:—"In securing the development of new forms in adaptation to the new environment, Natural Selection is supreme. Hence arises the real distinction, though we may not always be able to distinguish them, between specific and non-specific or developmental characters. The former are those definite, though slight, modifications through which each new species actually became adapted to its changed environment. They are, therefore, in their very nature useful. The latter are due to the laws which determine the growth and development of the organism, and, therefore, rarely coincide exactly with the limits of a species."

Mr. Wallace here leaves "sports" out of consideration altogether, but separates the "definite," *i.e.*, the adaptive characters or variations, out of the numerous "indefinite," ill-adapted, or injurious variations (which he also omits to mention), which, according to Darwinism, Natural Selection has eliminated.

So that we have the following groups of variations:—

1. "Large and striking variations or sports" (writer in NATURAL SCIENCE).

2. "Numerous small" (writer in NATURAL SCIENCE), *i.e.*, the same as the "developmental or non-specific characters" (Wallace). These I will call "Individual variations."

3. "Adaptive or definite characters" of true varieties and species (Wallace and myself).

4. Ill-adapted, or useless, or injurious, or "indefinite" variations, eliminated by Natural Selection (Darwinism).

As far as plants are concerned I would suggest instead the three following groups:—

1. Sports, occurring mainly under cultivation, and probably rarely supplying the source of varieties and species in nature.

[1] *Fortnightly Review*, March, 1895, p. 444.

2. Innumerable, slight, individual variations—the "developmental characters" of Wallace, because they are due to the ever varying growth and development of the plant. They are usually transient, *i.e.*, not hereditary and "non-specific" (Wallace), though they may become true varietal or specific characters under circumstances different from their normal conditions. Thus, *e.g.*, probably no two leaves of *Ranunculus Ficaria* are absolutely alike in this country, but the variations are insufficient to suggest any varietal differences. In the Mediterranean regions, however, the whole plant bears finer and larger flowers and leaves, so that it is generally recognised as the variety *Calthæfolia*.

3. Self-adapted varietal characters, which do not exist until called into existence by a pronouncedly different environment. These are the main sources of true varietal and specific characters, and give rise to the well marked "facies" of plants growing in deserts, marshes, water, etc.

Variations (as of number 2) in the parts of plants of the same species, when growing in the same place and under the same conditions, are very common. Mr. Burkill, for instance, has lately alluded to variations in floral symmetry, which I called "symmetrical reduction."[2] He describes the numbers of stamens and carpels in the flowers of several plants; thus he says:—"*Ranunculus Ficaria* showed that towards the end of the flowering period both the stamens and carpels become reduced in number without their proportion being changed."[3] He regards temperature as a cause. I have had more than one occasion to allude to this feature of "reduction," as well as of "symmetrical increase."[4] The former is sometimes attributable to a barren soil (tetramerous flowers of *Potentilla Tormentilla*), or to a feeble vitality (early flowering trimerous Fuchsias), or an accidental and locally insufficient supply of nutriment (tetramerous flowers in a corymb of elder, etc., in pentamerous instead of hexamerous flowers of *Lythrum Salicaria*, and in dimerous flowers of iris, orchids, etc.) On the other hand, symmetrical increase is due to hypertrophy; as in a large tetramerous crocus now before me, in heptamerous, central flowers of a glomerule of *Lythrum Salicaria*, and in the polymerous flowers of cultivated auriculas, etc.

Symmetrical increase is, of course, quite a different thing from "doubling"; as this latter is due to the conversion of stamens and carpels into petals, coupled with their multiplication.

I would here observe, that a reduction as well as an increase of the symmetry may be transient, as in all the preceding plants mentioned, except the Tormentil, in which the quaternary flowers have now assumed a truly specific character. Similarly, speaking

[2] Note on the "Causes of Numerical Increase of Parts of Plants," *Journ. Linn. Soc.*, 1877; "Origin of Floral Structures," p. 18, etc., 1888.

[3] *Nature*, Feb. 7, p. 359, 1895.

[4] The reader may be referred to my paper on "Self-Fertilisation" (1877), and that on "Æstivations" (1876) in the *Trans Linn. Soc.*

generally, all plants can become temporarily depauperised by atrophy; but if the poor environment be perpetual, then the variety "*depauperata*" can become relatively "fixed," and is often recognisable as such by systematists.

As another class of variations in individuals, their æstivation may be mentioned. If buds of *Laurustinus*, primroses, wallflowers, etc., be examined, every variety of æstivation can be pretty well met with in each. If æstivations, however, be constant, as in mallow, then they become classificatory characters. Lastly, Mr. Scott Elliot has given interesting statistics of the varying dimensions of leaves due to varying amounts of illumination, etc.[5]

Now, all these comparatively slight individual differences, and very many others that might be mentioned, arise, as it seems to me, because *no two organisms of the same species can grow with a mathematically exact likeness;* so that the laws of growth and development of organic beings cannot be compared with, say, gravitation and the laws regulating the constant angles of crystals.

As long, however, as wild plants are all growing together in the same natural environment, such variations in one and the same species, or in different flowers on one and the same individual plant, do not amount to true varietal or specific differences in the eyes of a systematist. Yet it is just out of these that Natural Selection is supposed to make its choice; but in point of fact it cannot do so.

Though this statement may be opposed to the prevailing creed, I think it is correct and in agreement with Mr. Wallace's statement of such characters being "non-specific." Thus the writer in NATURAL SCIENCE says (p. 218):—"It may be taken for granted that most biologists agree that variations of a nature similar to those now occurring among plants and animals have been the source of the differences between the varieties, species, genera, and so forth, in which existing animals and plants are classified." According to Darwin, such variations supply the materials for Natural Selection; but observations do not seem to me to support this view. The writer proceeds to observe, and very rightly, that "the chief difficulty in [this] view is that it is impossible to see in many cases, perhaps in any case, how small variations could have a value in selection; how, in fact, the gradual increments in a continuous change could each have had a determining value in the selection of the animal or plant."

Let us test it by an example. *Caltha palustris* has itself no recorded variety in low-lying situations; yet Mr. Cockerell[6] has been able to enumerate a great variety in the number of carpels of plants growing in one place, Corfe; and, presumably—as it, at least, is usually the case with *Caltha*—growing more or less crowded over marshy ground. Notwithstanding all its variations, Natural Selection appears to stand aside and to look upon all of the innumerable small

[5] *Journ. Linn. Soc.* xxviii., p. 371, 1891.
[6] *Nature*, March 21, 1895, p. 487.

variations, due to growth and development of each individual specimen, with perfect indifference, year after year, and in every one of the numerous localities where marsh-marigolds grow; and it makes no effort to see if it can select any particular form which might possibly be able to start on a new evolutionary career. For, *no variety has ever arisen in England in low-lying situations.*

When, however, this plant manages to get away from its habitual environment and to reach "mountainous places" (Hooker), it puts on characters which descriptive botanists have independently noticed and variously named as varietal or specific.[7] It is commonly known as *Caltha minor*.

These two kinds, or the highland and lowland forms of *Caltha palustris*, would, therefore, seem to illustrate Mr. Wallace's two terms "definite or adaptive" and "developmental or non-specific" characters respectively; only he has omitted to mention, as I said above, the "indefinite" characters of the majority of individuals, out of which Natural Selection is supposed to have selected the "definite" form known as *Caltha minor*. The fact is, there is no evidence whatever that they ever did exist. *Caltha minor* illustrates Darwin's assertion about the "definite action" of an environment, namely, that under such, "a new sub-variety would be produced without the aid of Natural Selection."[8]

But, let us not forget that what is true for *Caltha* is, of course, true for all other plants. It may stand as a type of the origin of *all* true varieties of plants, or "incipient species," as Darwin calls them. In other words, of the primeval seeds of *Caltha palustris*, which happened to be transferred from lowlands to mountainous places, *all* that survived grew up in direct adaptation to the new alpine environment, and so formed the so-called species *Caltha minor*, "without the aid of Natural Selection." But this change could never have occurred without the physiological self-adaptibility with which living protoplasm is endowed. It is here, therefore, as I take it, that the writer in NATURAL SCIENCE very rightly insists upon the *sine quâ non* of "function" being taken into account when "the question of species and of changes in them are to be dealt with" (p. 219). "The question as to whether such small dimensions [as observed by Professor Weldon] have, or do not have, a selection-value for the animal remains to be answered" (p. 220.) My reply is that under usual conditions of growth and development, in plants at least, they have no selection-value at all.

The Note adds: "Professor Weldon's method concerns itself merely with the fact that in certain cases there is a *relation* between selective destruction and certain specified dimensions." Is the word "destruction" the right word to use? The crabs measured, however abnormal, were all alive and well, and of the same age. I would

[7] See Hooker's "Students' Flora of the British Islands," p. 11.

[8] "Animals and Plants under Domestication," ii., pp. 171, 279.

suppose that they are like plants, in that the varying features of their structure, that is of numerous individual crabs respectively, were simply due to growth and development being never exactly alike in any two, and, therefore, not to be trusted as hereditary. It is not, therefore, that any crabs are "destroyed" in consequence of slight abnormalities or deviations from the average form, but that their variations are not necessarily reproduced in their offspring, which might vary slightly again, either towards the average form or in some other way. Hence, I do not quite agree with the writer in saying: "It is clear from the data that there must be a special death-rate among crabs which have a certain deviation from the normal in the case of the frontal breadth, and that there is no special death-rate among crabs with deviations of the right dentary margin." Without evidence, I would suggest the above interpretation as probably the correct one, as none of the 7,000 specimens appear to have been actually malformed, or more sickly or more likely to die sooner than the rest, or less likely to produce healthy offspring.

To return to the origin of *Caltha minor*. It might, of course, be said that all the "indefinite," ill-adapted variations, which may be supposed to have put in an appearance on the mountains, together with the few adaptive individuals, have all died out ages ago; and this could neither be proved nor disproved to have been the case. But many experiments have shown that if plants, or even half of an individual plant, or their seeds, be taken from lowlands and planted on alpine regions, all those that change their structures, at once begin to assume more or less the same anatomical and morphological characters as the plants normally growing on highland regions. On the other hand, they never produce any "indefinite," much less any "injurious" variations, as has been so completely proved by Messrs. Bonnier, Flahault, and others. We may look, but we shall look in vain for them; for there are no *facts* in support of the existence of innumerable indefinite variations for the benefit of Natural Selection, other than those due to growth and development; but these, as in the case of *Caltha*, supply no sufficient material for Natural Selection; as a rule they are "non-specific," according to Mr. Wallace, and I entirely agree with him.

On the other hand, there is an overwhelming amount of evidence, both from nature and experiment, that self-adaptation to a new environment is the true and only method of evolution, without any aid from Natural Selection at all.

The point I would, therefore, emphasise is, that Professor Weldon's statistics among crabs (and cows, horses, pigs, dogs, and human beings themselves, would readily supply analogous ones), as well as similar data among plants, prove nothing of themselves, beyond the patent fact that they are all due to the irregularities of nutrition, and are, consequently, the "inexact" results of the laws of growth and development of organic beings. Whenever, however, any one or

more of these numerous slight variations become extra stimulated by a new environment, *then*, they may become varietal, provided the stimulus be prolonged sufficiently to "fix" the character. Thus *Ranunculus Ficaria* has become as stated, the var. *Calthæfolia* in Malta, etc.; while *Caltha palustris* has become *C. minor* on mountains, and has (it is believed) developed the variety *plena* under cultivation.

One more quotation from the writer in NATURAL SCIENCE:—"Although Professor Weldon did not say so, it must have occurred to many listeners that this first result of statistical inquiry on variation was in direct contradiction to those who assert that variation is not a matter of 'chance,' but that it occurs in determined directions (p. 218)." As far as the ordinary, but innumerable, slight variations, due to growth and development, are concerned, they may very well be attributed to chance; for they are the results of accidental differences of nutrition, light, etc., and are, as Mr. Wallace rightly calls them, "non-specific." But I, for one, do maintain that *true* varietal and specific variations *do* occur in determined—but certainly not *pre*-determined—directions; because they do not arise until some external and sufficient cause occur to determine the special direction in which any particular organ, or organs, of the organism shall grow and develope—as I have shown in the example of *Caltha palustris* and *C. minor*. *Ex uno disce omnes.*

GEORGE HENSLOW.

IV.

The After-Shocks of Earthquakes.

NO severe earthquake ever occurs without numerous attendants of a slighter character, a few of them preceding, but by far the greater number following it, and continuing to be felt for many months afterwards. Their unusual number, their immediate succession, and their gradual decline in frequency with the lapse of time, as well as their geographical distribution, point unmistakably to the existence of an intimate connexion between the earthquake and its after-shocks.

From whatever point of view we look at earthquakes, but especially if we regard them as the results of fault-slipping, the study of after-shocks is of great importance. At the same time, it is a study frequently encompassed with serious difficulties. In the presence of a terrible disaster, slight shocks are only too likely to be neglected. Their number is often so great that even a cool-headed observer may give up in despair the attempt to chronicle them. And, again, supposing his record to be nearly complete, the interval between successive shocks may be so small that their identification with those noted by other observers may be nearly, if not quite, impossible. Thus, the distribution of after-shocks, with regard to space, is a subject on which we must at present be content to remain in partial ignorance, except in those cases where the shocks are few, or where seismographs are abundant, and escape injury during the chief disturbance.

The distribution of after-shocks, with regard to time, is a subject which lies more within the range of investigation. It has recently been discussed with great ability by Mr. F. Omori, of the Seismological Institute at Tokio (3, 4). Within the last six years there have been three earthquakes of unusual severity in Japan: those of Kumamoto, on July 28, 1889, Mino-Owari, on October 28, 1891, and Kagoshima, on September 7, 1893; and, fortunately, in each case there has been an observatory provided with a seismograph in the immediate neighbourhood of the epicentre.[1] Except within a few hours of the earthquakes, the records of these instruments may be

[1] The "epicentre" is the area on the earth's surface vertically above the seismic focus or centre of disturbance.

regarded as complete, and Mr. Omori has subjected them to a careful analysis, of which the principal results are summarised in this paper.

One of the most interesting sections in Mr. Omori's memoir is that on the periodicity of the fluctuations in the number of after-shocks, but as this does not seem to have any necessary connexion with the present subject, I have, in order to save room, omitted all reference to it here.

As the results, to a certain extent, are the same in each case, it will be sufficient to describe a single earthquake in some detail, with a brief reference to the others. That on which our knowledge is most complete is the Mino-Owari earthquake, generally known in this country as the great Japanese earthquake of 1891.

Fig. 1. AREA AFFECTED BY THE EARTHQUAKE OF 1891.

This figure is reduced from a map appended by Mr. Omori to his paper on the isoseismal lines of the great Mino-Owari earthquake of 1891. I regret that I am unable to give the proper reference. But the omission is probably of little moment, for the paper is written entirely in Japanese.

The Mino-Owari Earthquake of 1891.—This great earthquake, one of the most disastrous within historic times, occurred on October 28, at 6.37 a.m. (mean time of 135 degrees E.). The area disturbed by it, including both land and sea, was not less than 320,000 square miles. Its boundary and the principal isoseismal lines[2] are shown in Fig. 1. In the region enclosed by the first isoseismal, the destruction of buildings was nearly complete; in the area of the second isoseismal,

[2] "Isoseismal lines" are lines of equal intensity of the earthquake force.

houses, walls, bridges, etc., were partially damaged; in that of the third, walls were cracked, clocks were stopped, and crockery fell off shelves; while between the third and fourth isoseismals the shock was distinctly felt. The first of these areas, which includes the provinces of Mino and Owari, and portions of those adjoining, is mapped on a large scale in Fig. 2. The continuous lines marked 1

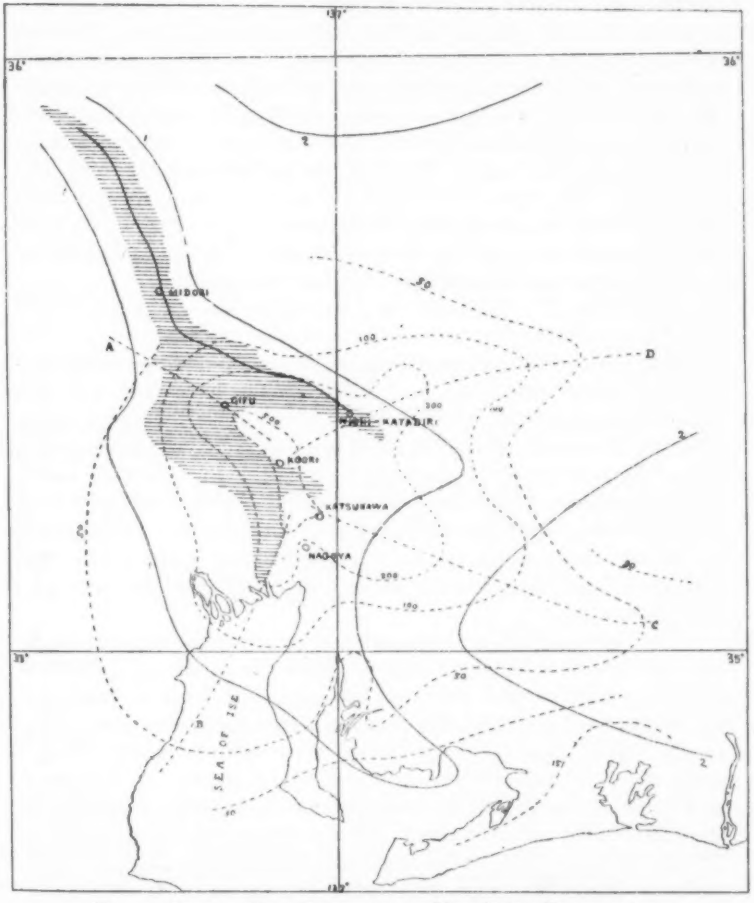


FIG. 2. AREA OF FIRST ISOSEISMAL OF MINO-OWARI EARTHQUAKE.

and 2 are isoseismal lines, along which the maximum accelerations were respectively 2,000 and 800 mm. per second. The shaded area is that which was shaken most strongly. The dotted lines will be referred to in a later section (*see* p. 397).

Within the shaded area will be noticed a somewhat sinuous line. This marks part of the course of the great fault-scarp, which has been admirably studied and described by Professor Koto. He succeeded in

tracing it from Nishi-katabiri to Haku-san, a distance of 40 miles, and there is good reason for believing that it extends as far as Fukui, *i.e.*, for a total length of 70 miles. Proceeding in a general south-east and north-west direction, it cuts through hills and plains alike. With one exception, the ground on the north-east side is relatively depressed, and it is also constantly shifted by as much as 5 or 6 feet towards the north-west. Where the vertical displacement is small, a mark was left like the track of a ploughshare or of a gigantic mole. In other places, where the fault crosses flat ground, it has the appearance from a distance of a railway embankment. This is the case at Midori, in the Neo Valley, where the bed of the valley is split longitudinally, and an abrupt step formed, from 18 to 20 feet in height. When we think of the remarkable length of this fault, the magnitude of its throw, and the friction that must have resulted from the rapid displacement of such enormous masses of rock, we can entertain but little doubt as to the correctness of Professor Koto's conclusion that the formation of the fault-scarp was the cause of the great earthquake (1).

Distribution of After-Shocks in Time.—Gifu, the capital of Mino, lies about 4½ miles from the nearest point of the fault-scarp. The seismograph at the meteorological observatory there recorded the first half-dozen vibrations, and then the building fell and the instrument was buried. At 2 p.m., *i.e.*, about seven and a half hours after the earthquake, it was again in working order, and the registration of the after-shocks commenced. From this time until the end of December, 1893, or within a little more than two years, the total number of after-shocks recorded is 3,365. Of these, ten are described as violent, ninety-seven strong, 1,808 weak, and 1,041 feeble; the remaining 409 being merely sounds unaccompanied by any perceptible motion.

The relation between the number of after-shocks and the time since the great earthquake is shown graphically in Fig. 3. The dots denote by their distance from the horizontal line the total number of shocks recorded during each successive month from November, 1891, to December, 1893. The continuous curve, which passes through these dots, exhibits very clearly the rapid decline of frequency during the first two months and the much slower rate of decrease at the end of five or six months. For instance, in November and December, 1891, there were 1,087 and 416 after-shocks respectively; while in December, 1892, there were only thirty-nine, and in the December following not more than sixteen. At the same time, this decline is not continuous, there being several maxima and minima, though not of great importance. Smoothing away these irregularities, we get the dotted curve in the figure, and this, it will be seen, approximates very closely to the form of a rectangular hyperbola. If this curve represents the true law of decline in frequency, it follows that the monthly number of shocks must go on diminishing, until, after a lapse of about forty years, the ground will

have so far recovered its former stability that there will be no more than one slight shock a month. By this time the total number of after-shocks recorded at Gifu will probably not fall short of four thousand. Before 1891, the average yearly number of shocks at the same place was about fifteen.

Another point of some importance is the connexion between the intensity of the shocks and their time of occurrence. Of the ten violent shocks recorded at Gifu, nine occurred within the first four months, and the last in September, 1892. All of the strong shocks took place within the first thirteen months, and all the weak ones but

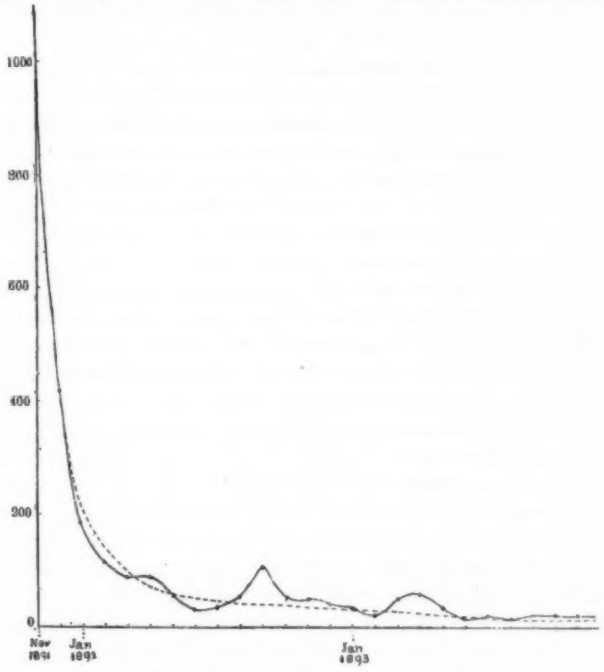


FIG. 3. CURVE SHOWING DIMINUTION OF AFTER-SHOCKS IN TIME.

four within the first twenty months. During the few days immediately succeeding the earthquake, feeble shocks and sounds were comparatively rare, and it was only after the lapse of several weeks that they came into prominence. Towards the close of the year 1893, with the four exceptions just alluded to, feeble shocks and sounds alone were recorded.

The remaining earthquakes discussed by Mr. Omori were less intense, and the number of after-shocks was, in each case, much smaller. They yield, however, somewhat similar results.

The Kumamoto earthquake occurred on July 28, 1889, at

11.49 p.m., and disturbed an area of more than 38,000 square miles. Up to the end of 1893, 922 after-shocks were recorded at Kumamoto. One of these, five days after the principal shock, was violent, seventy-six were strong, and 845 weak or feeble shocks, or else merely sounds. The curve representing the decline in frequency is somewhat similar in form to that of the Mino-Owari earthquake, and shows that, after a total lapse of about seven or eight years, the annual number of shocks will once more have attained the value which it had before the earthquake of 1889, namely, three or four a year. Thus, the disturbed condition of the earth's crust in this district is now approaching its end, and the complete number of after-shocks will probably be about 950 or 1,000.

The Kagoshima earthquake, which took place on September 7, 1893, at 2.46 a.m., disturbed an area of about 30,000 square miles. The record of after-shocks at Chiran, in the epicentral district, began at about 9 p.m. In the interval, there were probably about a hundred shocks, so that by the end of January, 1894, the total number must have been nearly 480. The annual number will probably return to its original value after a lapse of three or four years, by which time some six hundred shocks may have been felt.

The number of earthquakes discussed is too small to draw any general conclusions; but so far it would appear that the more intense the original earthquake the greater is the number of its after-shocks.

Distribution of After-Shock Frequency in Space.—When many earthquakes occur in the same district, it does not follow that they all proceed from one centre of disturbance. Probably, a continual displacement of the centre, resulting from a relief and transference of stress at each successive shock, is the more general rule. To make our history of an earthquake-series approach completeness, we ought, therefore, to know the disturbed area and epicentre of every shock, and this would enable us to trace the laws according to which the disturbed portion of the earth's crust gradually settles down into equilibrium again. But, as already remarked, this is in many cases a task of peculiar difficulty, and, with the Mino-Owari earthquake, one that it was impossible to perform. The large number of after-shocks in this case, however, renders another method applicable, for the suggestion of which we are, I believe, indebted to Mr. Omori. This is the distribution of after-shock frequency with regard to space.

Besides the seismographic records from Gifu and Nagoya, earthquake reports were sent in from district offices and other stations in the three provinces of Mino, Owari, and Mikawa. These give, with a general approach to accuracy, the monthly numbers of after-shocks from November, 1891, to February, 1894. Plotting such numbers on the seismic map, curves may be drawn through places where equal numbers of after-shocks occurred during stated intervals. Mr. Omori gives three such maps—one for 1892, another for 1893, and the third

for January, 1894. In Fig. 2 the curves on the map for 1892 are reproduced as dotted lines.

It will be obvious from a glance at these curves that the after-shocks were most frequent, not in the Neo Valley, where the great fault-scarp was formed, but in a district to the south-east of it, in the Mino-Owari plain. For some time after the great earthquake the most active centre of after-shocks was situated close to Gifu, probably just to the west of the town. During 1892, as is shown in Fig. 2, there were four axial lines (A–D) radiating from the neighbourhood of Koori, along which after-shocks were more numerous than in other parts of the district.

In succeeding years the distribution of seismic activity underwent some changes. The curves of equal frequency during 1893 show a diminution along the axial line marked A, while the prominence of shocks along the axial line B almost entirely disappears. The other two lines, however, remain still distinct, and, during January, 1894, are the only representatives of the original number. This is due to the fact that, on the 10th of this month, a severe earthquake occurred, whose origin was situated at the point where these two axial lines intersect. Two other severe earthquakes on January 3 and September 7, 1892, also originated in the Mino-Owari plain, one close to Gifu and the other near Katsukawa. All three, therefore, had their centres close to the axial line A C running W.N.W. and E.S.E.

The interpretation of these facts seems to be, as Mr. Omori suggests, that a prominent fracture or series of fractures exists beneath the Neo Valley, and that by the great earthquake the stress in this district was almost completely removed. The axial lines radiating from Koori probably indicate the existence of four slighter or deeper fractures, along which the crust is still gradually settling down into equilibrium, that condition not being yet attained. The centre of after-shocks, Mr. Omori concludes, may still further change its position; but he considers it more probable that it will recede from, rather than approach, the Neo Valley.

REFERENCES.

1. **Koto, B.**—"The Cause of the great Earthquake in Central Japan, 1891." *Journ. Coll. Sci. Imp. Univ. Japan*, vol. v., pt. iv., 1893, pp. 295–353.

2. **Milne, J.**—"A Note on the great Earthquake of October 28, 1891." *Seismological Journ. Japan*, vol. i., 1893, pp. 127–151. *Brit. Assoc. Rep.*, 1892, pp. 114–129.

3. **Omori, F.**—"On After-shocks." *Seismological Journ. Japan*, vol. iii., 1894. pp. 71–80.

4. ————.—"On the After-shocks of Earthquakes." *Journ. Coll. Sci. Imp. Univ. Japan*, vol. vii., pt. ii., 1894, pp. 111–200.

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V.

Eozoön and the Monte Somna Blocks.

IN consequence of the Note in our February number, entitled "Eozoön: Requiescat in Pace," as well as our remarks on the letter written to us by Sir William Dawson and printed on p. 288, we have received several more letters from Sir William, strongly protesting against the re-burial of *Eozoön*. He has also enclosed a criticism on what he calls "the strange mis-statements" contained in the paper on "Eozoönal Structure of the Ejected Blocks of Monte Somna," by Drs. Johnston-Lavis and Gregory (*Trans. R. Dublin Soc.*, vol. v., ser. 2). In consequence of the great interest that has been aroused by this paper, we print Sir William's criticism in full, together with a short reply by Drs. Johnston-Lavis and Gregory.

I DESIRE to make a few remarks on the paper by Dr. Johnston-Lavis and Dr. J. W. Gregory, not for the purpose of entering into the general questions relating to the organic structure of *Eozoön*, but to indicate certain reasons for the belief that the appearances described in the paper have no relation to *Eozoön canadense*, either in mode of occurrence and mineral character or in microscopic structure, and consequently that, whatever the interest and value of the paper in other connections, the references to the Laurentian fossil are wholly gratuitous and unnecessary, while they are also in very important respects incorrect.

In making these criticisms I shall, for the sake of simplicity, refer only to those typical specimens of *Eozoön* in which the laminæ remain as calcite, while the chambers are filled with serpentine or more rarely with malacolite, and the canals and tubuli with serpentine or dolomite.

1. *Mode of Occurrence and Mineral Character.*—The paper states in three distinct places that the typical *Eozoön* is enclosed in a pyroxenic igneous rock, as follows:—

Page 260. "The typical Eozoönal nodules occur enclosed in a rock of which a white pyroxene is the leading constituent."

Page 275. "Concentric Eozoönal masses are included in a coarse-grained rock which is composed of white pyroxene, and which, therefore, may safely be regarded as igneous in origin."

Page 277. "The Cote St. Pierre spheroids (of *Eozoön*) are probably cases of blocks included in either a volcanic or plutonic mass."

By implication this mode of occurrence is also assumed throughout the paper. The statement is, however, entirely without foundation, and I am at a loss to understand whence it has been derived. It certainly could not have been from any competent observer who has studied *Eozoön* in situ. In point of fact the best specimens have all been found in a thick limestone, the Grenville Limestone of Sir William Logan, estimated by him at 750 feet in its average thickness, though with a few intercalated thin bands of gneiss and quartzite.[1] In the vicinity of Cote St. Pierre in the Seigniory of Petite Nation, where some of the best specimens of *Eozoön* are found, the outcrop of this limestone has been traced continuously and mapped by the Geological Survey for twenty-five miles, and in the same district it occurs over an extent of more than one hundred miles on the reverse sides of synclinal and anticlinal folds, where it may be recognised by its character and associations as well as by its holding *Eozoön*.[2] It is true that grains, nodules, and thin interrupted bands of a white variety of pyroxene (malacolite) occur sparingly in this limestone; but neither in their chemical composition nor in their mode of occurrence have we any proof or even probability of an igneous (intrusive) origin. This was the matured conclusion of the late Dr. Sterry Hunt; and Dr. F. D. Adams, at present our best authority on these rocks, is of the same opinion.

The Grenville limestone has been much bent and folded, and with its accompanying beds has been subjected to regional metamorphism. In the Petite Nation localities, however, it has not, as far as known, been invaded by igneous dykes or masses.

The specimens of *Eozoön* are included in this limestone, and vary from single individuals ranging from an inch to six inches in diameter to aggregated groups of a foot or more; and microscopic examination shows that, in some of the beds in which they occur, there are innumerable fragments showing the same structures scattered on the strata planes, and associated with the minute globular chamberlets which I have named *Archæospherinæ*. The specimens of *Eozoön* may be seen weathered out on the surfaces of the limestone exactly in the manner of stromatopcres on the surfaces of the calcareous rocks of the Cambrian, Ordovician and Silurian, though I have not seen them so crowded together as in some of the beds of these later formations.

From the statements quoted from Mr. Blake (p. 274) and some remarks on p. 275, I would infer that the authors possibly contemplate *Eozoön* in an inverted position, with the acervuline part within or

[1] "Geology of Canada," p. 45. See also "Life's Dawn on Earth," and Memoir on "Specimens of Eozoön Canadense." By the Author. Montreal, 1888.

[2] It must be evident that the singular opinion quoted on p. 277, that even these great continuous Laurentian limestones may themselves have been "inclusions in intrusive igneous rocks," is too monstrous to be entertained for a moment, especially in opposition to the judgment of all the ablest geologists who have studied them.

below, and the thicker and more regular laminæ above or without. I need scarcely say that this would be in direct opposition to the descriptions of Dr. Carpenter and myself, based on the study of a great number of specimens in situ. I observe, however, that Zittel (Palæontologie, fig. 47) places *Eozoön* in this inverted position, which may have led to the error in question.

It is proper perhaps to repeat in this connection that, in certain layers of the Grenville limestone, grains and concretions of serpentine and malacolite occur without *Eozoön*, and specimens of *Eozoön* with only so much of such minerals as may be contained in their chambers. There are also instances in which specimens of *Eozoön* occur attached to or partially imbedded in such nodules, just as sponges and other organisms occur associated with flints in chalk, or as stromatopores occur in connection with concretions of chert in Palæozoic limestones. As to the origin of the concretions themselves, from whatever source their materials may have been originally derived, their isolation in the limestone and the manner in which they occur in connection with surfaces of deposition, render it certain that their introduction as well as that of the individuals of *Eozoön* was contemporaneous with the formation of the limestone.

Quite recently Kemp and Smyth, two able U.S. geologists, have published (*Bull. Geol. Soc. Amer.*, March, 1895), Observations on the Laurentian Limestones of the Adirondack Region of New York, in which they fully recognise their extended and sedimentary character, though in that mountainous region they are even more altered and disturbed, and also more invaded by igneous masses than in the Canadian area. They do not seem to have met with any "contact-banding" comparable to *Eozoön*, though from microscopic examination I know that detached fragments of *Eozoön* exist in some of the limestones of the Adirondack region.

The above plain statements of facts are, I think, sufficient to show that the specimens of *Eozoön* found in the Laurentian limestones of Canada in no respect resemble in their associations and mode of occurrence the banded forms from Mt. Somna described in the paper in question. Additional details may be found in my Memoir on the "Specimens of Eozoön in the Peter Redpath Museum," and in other publications referred to in that work.[3]

2. *Form and Structure.*—In so far as can be judged from the plates, some of the forms described in the paper lie in bands parallel to igneous veins, like the laminated borders or selvages common in every part of the world, and of which we have good instances in the trappean dykes of the Montreal mountain; or they appear as rounded masses in the manner of nodules or geodes. Thus, in so far as mere lamination or banding is concerned, they have a certain resemblance to *Eozoön;* but, on closer inspection, essential differences may be

[3] Montreal, 1888, pp. 106. See also "Salient Points in the Science of the Earth" by the same author, 1893.

observed which I have no doubt would be farther accentuated by comparison of actual specimens.

I have already referred to the apparent inversion of acervuline and laminated structures; but there is a more important difference than this, at least, in several of the figures. The Vesuvian specimens, as shown therein, consist of continuous laminæ of crystalline igneous matter, including interrupted or lenticular layers of calcite. *Eozoön*, on the contrary, when well preserved, consists of a continuous skeleton of calcite composed of broad layers slightly pitted on their surfaces, and connected at intervals; while the silicious material appears as a substance filling wide, flattened, mammillated chambers, more or less limited, and presenting amœboid lobes at their extreme edges, and passing finally, in the upper part, into rounded chamberlets. This difference should commend itself to any palæontologist; but I am aware that it may be overlooked by cursory observers. Scores of specimens have been sent to me of banded rocks, supposed by their finders to resemble *Eozoön*, though, in arrangement of parts, the converse of it.

The authors of the paper seem to have peculiar ideas respecting even the general form of *Eozoön*. I have repeatedly shown, and have illustrated this by photographs, that when we find perfect detached individuals of *Eozoön*, these are usually of inverted conical form, springing from a narrow base and widening upward in the manner of some sponges and corals. When close together they often become confluent, and when these confluent masses or layers appear to be hollow or doubled, I believe that this usually results from the folding of the containing bed. This can, indeed, often be seen to be the case, and the laminæ may be observed to be bent and crushed at the flexures.

In the specimens figured in the paper, the characteristic microscopic structures of *Eozoön* are entirely absent. There is no trace of the beautiful and complicated system of canals, and the fibrous structures compared with the minute tubulation are merely prismatic fibrous crystals like the secondary veins of chrysotile which sometimes cross and deteriorate our specimens of *Eozoön*. With reference to these chrysotile veins, while their filling of minute and often transverse and branching cracks show that they are merely aqueous deposits of later origin than the structures which they traverse, and while their appearance under high powers is very different from that of the tubuli of the calcite layers, they have no doubt been when parallel to the layers, and in poor specimens, fertile causes of error. Fortunately, however, they are absent from the more perfect specimens. I may also explain that while the finely tubulated margin of the calcareous layers can be seen to terminate abruptly against the filling of the chambers, it passes gradually in the interior of the layer into the larger canals when these are present. Naturally also, the finely tubulated wall often fails to show its structure, just as anyone who has

examined large series of sections of nummulites may observe in these fossils: and the tubuli are often filled with dolomite or calcite very difficult to distinguish from the substance of the calcareous lamina.

The authors of the paper refer (p. 272) to the late Dr. Carpenter as having failed to distinguish the chrysotile veins from the proper wall; but when in England, not long before his lamented decease, I had the pleasure of going over his collection of slices with him, and of ascertaining that he quite understood the distinction between the veins of asbestiform serpentine and the organic structures. At that time he hoped to have prepared an exhaustive memoir on the subject, including my material as well as his own. Had he been permitted to fulfil this intention, many subsequent mistakes might have been avoided. Even his collections, though varied and admirable, are, in a case of this kind, of comparatively little value without their skilled interpreter, so full of varied knowledge.

The writers of the paper do not seem to notice that in the St. Pierre specimens the fine canals and tubuli are often filled with transparent dolomite, difficult to perceive without very good preparations and properly managed light, but of extreme beauty when these conditions are fulfilled. In roughly prepared specimens, indeed, and without careful attention to illumination, these delicate structures are often quite invisible. I have sections properly prepared which show the finest and most complicated tubulation in a manner equal to anything I have seen in any fossil foraminifera from more recent formations; while other slices cut from the same specimen, but possibly slightly heated or subjected to mechanical jars in polishing, show little except the curdled appearance of the serpentine and a multitude of cleavage planes in the calcite. In like manner in preparing decalcified specimens, a little heat or an acid too strong or not quite pure, may remove all the dolomitic casts of tubuli, and may erode those of serpentine. From causes of this kind I fear many who have pronounced very decided opinions on *Eozoön* have not actually seen perfect examples of its structure.

While, therefore, I must agree with the writers of the paper that their specimens from Somna belong to the category of those banded structures found in concretions and geodes, and at the lines of contact of igneous and aqueous rocks, which are not unfamiliar to those who have advocated the organic origin of *Eozoön*, and which they have all along been solicitous to distinguish from it, I must emphatically deny that they resemble either in composition, mode of occurrence, or form and structure, the Laurentian *Eozoön* of Canada. The present writer, indeed, regards it as little complimentary to his long experience of rocks and fossils to suppose him guilty of the error of judgment implied in such a resemblance, and, therefore, begs to say that had he been privileged to examine the now celebrated specimen from Somna in the British Museum, or had he seen such things in the escarpment of that old volcano, or had his friend Dr. Johnston-

Lavis been kind enough to show him such specimens in his collection at Naples, he would probably have declined to acknowledge their true affinity to *Eozoön*. But, of course, we must bear in mind the organic possibilities in metamorphosed rocks which Brögger has so well illustrated in Norway; though even in Canada we cannot yet parallel his *Orthis calligramma* moulded in garnet.

The gradual discovery of new forms of pre-Cambrian life in Europe and America, will soon compel palæontologists to give more attention to this neglected portion of their science. The discoveries of Billings, Cayeux, Walcott, Matthew, and others have already established a probability that, besides *Eozoön*, the pre-Cambrian rocks contain other stromatoporoid forms (*Archæozoön Cryptozoön*) as well as sponges, radiolarians, worms, and possibly elementary types of mollusks and crustacea. Dr. Adams has also made much progress in separating the truly sedimentary beds of the Canadian Laurentian from those that may be referred to the crushing and deformation of igneous products. Perhaps, however, the time has scarcely yet come for summing up the evidence.

J. William Dawson.

Sir William Dawson's remarks call for some reply, as he seems to have overlooked or misunderstood some points having an important bearing.

He distinctly passes over the table of necessary conditions for the occurrence of eozoönal structure on pp. 264–65 of our paper, and then describes the mode of occurrence of the so-called fossil in Canada, which is provided for under section (*b*), on p. 265. All we require for the formation of eozoönal structure is the contact of a rock containing silicates, with a limestone more or less magnesian, both being exposed to a high temperature. Whether such an association be due to the injection of veins of igneous rock (either remaining as dykes or broken up into separate masses); whether boulders of old volcanic or other rocks containing silicates were enclosed at the time of the sedimentation of the limestone; or whether beds of detrital silicates were interstratified with limestones, does not matter. We repeat that all we want is the association of these two types of rocks in close contact with each other, and a sufficient supply of heat, time, and pressure. Then, along the line of contact, both rocks will undergo alteration, and this eozoönal structure be developed.

Sir William Dawson expresses surprise at our statement that a white pyroxene occurs as a leading constituent in the rock in which the masses of *Eozoön* occur, and is at a loss to understand how it can have been made. He assures us that it is entirely without foundation. In reply, we refer Sir William Dawson to some of Dr. Carpenter's choicest specimens, to some which he had photographed to illustrate the "exhaustive memoir," which Sir William reminds us he intended to

prepare. The matrix of some of these is composed almost entirely of white pyroxene.

We understand that further information will be published shortly in relation to the mode of occurrence of some of the typical Canadian *Eozoöns*, and that this is far more in agreement with the theory we proposed than with that of the organic origin of *Eozoön*.

Our specimens show both the silicate bands and the calcite bands as lenticular, as in Figs. 1 and 3 (especially at top and right side of 3), pl. xxx. In pl. xxxiv. the silicate laminæ are distinctly lenticular and are interrupted. In many of Carpenter's specimens the silicate bands are certainly continuous, and the calcite bands lenticular and interrupted.

The mammillation of the chambers in the Canadian *Eozoön* is observable with the serpentine, but not with the so-called malacolite bands, and is simply due to an arrangement commonly assumed by amorphous serpentine.

As to the shape of masses of *Eozoön* we can place at Sir William Dawson's disposal a great variety, and we could have devoted a hundred pages to descriptions of variations both in shape and structure; but space and the patience of our readers forbade. Both of us have had some practice in the examination of organic and mineral structures under the microscope, and can appreciate the resemblances and differences between them. Of the two, some of the Vesuvian specimens far better mimic organic structure than do those we have seen from Canada.

Sir William Dawson tells us that Dr. Carpenter fully understood the differences between the chrysotile veins and the proper wall. He certainly did maintain this view for about twenty years, but then he admitted that he had been in error, and in the last published statement of his that we know, he accepted the proper wall as inorganic.

Sir William Dawson's memory has failed him, for the first author of the paper did show him some specimens when in Naples over a decade ago; but his suggestion as to their nature was so peremptorily dismissed that he feared to push the matter further, more especially as then no microscopic or even detailed examination had been made.

Neither of us wish to deny the existence of life in pre-Cambrian times; though we doubt whether all the cases quoted by Sir William will be verified by further research.

Finally, when Sir William Dawson denies that the specimens we described "resemble either in composition, mode of occurrence, or form or structure, the Laurentian *Eozoön* of Canada," we would only remark that when one of them was shown to the only geologist in England whom we could find who still had any faith in *Eozoön*, he declared it was an excellent specimen of the Laurentian *Eozoön* of Canada; and when he was told it came from Monte Somna he rejected the idea with scorn, and said that if it had, it had been first carried there from Canada.

H. J. JOHNSTON-LAVIS.
J. W. GREGORY.

VI.

In the Home of the Nautilus.

DR. ARTHUR WILLEY (formerly of University College, London) last year resigned the post of instructor in biology in Columbia College, New York, in order to accept the Balfour Studentship of the University of Cambridge. He undertook as a condition of his election to the studentship to proceed to New Britain in order to attempt the investigation of the embryology of the Pearly Nautilus. Dr. Willey was assisted in his equipment by a grant from the Government Grant Committee of the Royal Society of London, and started for his destination in last September. The following letter is the first received from Dr. Willey since he arrived in New Britain, and it shows that he is in a fair way to carry out the purpose of his journey, whilst it is full of matter interesting to naturalists, and will, I feel sure, be welcome to the readers of NATURAL SCIENCE.

E. RAY LANKESTER.

DEAR PROFESSOR LANKESTER,

When I arrived at Batavia at the beginning of last November, I had still upwards of three weeks to wait before going on to the Bismarck Archipelago by the North German Lloyd ss. "Lübeck," and accordingly wended my way to the magnificent botanical gardens, known as "'s Lands Plantentuin," at Buitenzorg. Here every kindness was shown me by the director, Dr. Melchior Treub, and by Dr. Janse.

My imagination having been for a long time excited by what I had heard of the extraordinary parasitic flowers of the Rafflesiaceæ, I made an excursion, accompanied by a most intelligent native employé of the gardens, to the virgin forest on the flank of the huge extinct volcano, Salak (West Java), where *Rafflesia Rochussenii*[1] was discovered by Teijsmann and Binnendijk in 1850, and is till now only known from this locality.

After a somewhat fatiguing scramble through the bush, the astonishing instinct of my guide led us to several groups of the sessile flowers, which are about the size of the closed fist, growing on the roots of *Cissus*, and almost concealed under the humus.

[1] *Rafflesia* is known to the Malays by the name of "padma besar," while the allied hermaphrodite genus *Brugmansia* is called "padma k'chil" (small padma). *Balanophora* is also called "padma."

It is a very rare thing to see the flowers expanded, and we were not fortunate in this respect, but in some cases the brown bract-like structures which surround the inflorescences had parted on the top so as to expose the flesh-coloured corolla.[2]

After this, through the kindness of Dr. Treub, I spent eight days at the mountain laboratory of Tjibodas, which has been erected within the last two or three years under his direction. It stands on the side of the still active volcano Gedeh, some 1,425 metres above the sea-level.

There is an extensive area of virgin forest here, which has been granted by the Government to 's Lands Plantentuin, and is now administrated by the well-known horticulturist, Mr. Henry Couperus.

In the immediate vicinity of the laboratory, a number of exotic trees have been introduced, most noticeable among them being a quantity of Australian conifers, chiefly species of *Araucaria*. But at this elevation they do not undergo fructification; they bear cones, but they are quite sterile. *Cupressus excelsa* (Australia) is the only conifer that bears fruit at Tjibodas. In the same way, cocoa-nut palms do not bear fruit here. On the sides of the pathway leading up to the laboratory are two of the curious Australian grass gum trees (*Xanthorrhœa hastilis*. Nat. Ord. Liliaceæ).

In the laboratory book at Buitenzorg, I had previously found an entry by Professor Max Weber to the effect that giant earthworms, called by the natives "tjatjing sondari," occurred in the neighbourhood of Tjibodas, and I gave my chief attention to these during my stay there.

The giant earthworms that are to be dug up here belong to the family of the Perichætidæ (as, in fact, did all the earthworms I saw in Java). When lying still upon the ground they may measure from eighteen to twenty inches, and when crawling may exceed twenty-five inches, with the girth of a small snake or blindworm. When first taken out of the ground the worms, especially the older ones, exuded a viscous dull greenish-yellow fluid from the dorsal pores in the hinder region only. They may even squirt the fluid up, by violent muscular contraction, to a height of some inches, which is rather an unpleasant fact when one is bending over them.

Once, while walking through the forest, one of these worms, a young one, dropped from a tree at my feet. On my expressing surprise, my native guide, whose intimate knowledge of bionomics filled me with envy, informed me that the "tjatjing sondari" were also to be found in the mould in which the large epiphytic fern *Asplenium nidus*, or "kadaka," grows, high up on the trees. On going later to verify this statement, I found it to be perfectly correct. From one kadaka I took three specimens, and from another six, and so on.

[2] For a recent admirable account of the Rafflesiaceæ *cf.* H. Graf zu Solms-Laubach "Ueber die Species in der Gattung Rafflesia . . . " in *Annales du Jardin Bot. de Buitenzorg*, vol. ix., 1891.

Of course, we could only examine those within our reach, but there is no telling how high the worms clamber. One kadaka, from which we obtained specimens, was growing far out on an overhanging branch about nine feet from the ground.

We got individuals from the kadakas, ranging from five to twenty inches in length, but always young, never with a well-developed clitellum, and my guide assured me that one never finds old worms in the kadakas. "Kalau k'chil ada di-kadaka, kalau bĕsar masok di-tana:" when small they live in the kadakas, when large they go into the ground. We did, however, obtain specimens without a clitellum in the ground, but not with a clitellum in the kadakas. Another singular fact in connection with those individuals which were obtained from the kadakas was that they never exuded the viscous fluid through the dorsal pores, but, strangely enough, squirted out a fluid, sometimes with great force, through the mouth. I repeatedly observed this. The very small ones did not exude any fluid. Both in the ground and in the kadakas the "tjatjing sondari" are accompanied by a common small species.

From the waxy contents of the tuber-like excrescences of *Balanophora*, which is very common on the Gedeh, the natives manufacture effective candles, or, more correctly, small torches, by plastering the viscous substance in an even layer, about one-eighth of an inch thick, round a long thin slip of bamboo. It is interesting to observe the manifold uses to which the natives put all kinds of plants.

On another occasion we came across the nest of a species of the lizard *Calotes*, containing four eggs. Under ordinary circumstances the *Calotes* is of a bright green colour, but one put into my pocket emerged a dark brown. The nest consisted of a hole in the ground, two to three inches in depth and nearly two inches in diameter. My guide had seen the lizard making this nest some three days previously, and on opening the eggs I found the young embryos to be at the corresponding stage of development, with the heart beating. This was another welcome proof of the trustworthiness of the native.

On the faces of rocks near Tjibodas I found a quantity of small caterpillars living on the powdery alga, which makes greenish-white patches on the rocks. The caterpillars had so completely covered themselves with the alga as to be only discernible by their movements on close inspection, and their disguise must effectually protect them from foes.

The name "djambilong" is applied both to large black fresh-water leeches and to *Bipalium*. I did not obtain any of the latter, although it is known to occur here.

On returning to Batavia, I enjoyed the hospitality of the British Consul, Mr. Rushton Lankester, for a few days, and finally left by the "Lübeck" on November 25.

During the first three days of the voyage from Batavia, I noticed a large number of snakes (Hydrophidæ), averaging from 18 inches to 2 feet in length, and ranging in colour from pure white, through yellow, to dark brown, floating on the surface of the sea. After the third day I saw no more of them; but they occur here in Blanche Bay.

After touching at several points on the coast of New Guinea to land goods, we at last anchored off Herbertshöhe on the evening of December 15, and next day I landed at Ralum, where I was received with great kindness into the house of Mr. Richard Parkinson, to whom I had brought a generous introduction from Dr. Anton Dohrn.

Mr. Parkinson, as is well-known, has himself produced works[3] of great ethnographic value, and my surroundings were, therefore, at once of a sympathetic description.

Later on Mr. Parkinson caused a commodious bamboo laboratory to be erected on the beach at Ralum, and with the assistance of Mrs. Parkinson, whose knowledge of the native language and character is most intimate, I purchased a small native hut on an island which was thrown up in Blanche Bay during an eruption in 1879, so that I could have an accessory laboratory and shelter in the immediate vicinity of the habitat of the Pearly Nautilus.

This island is called by the natives Rakaiya, which means "the spirit"; on the maps it is marked Raluan or Vulcan Island. It is rather badly placed for squalls and earthquakes, but is otherwise not unpleasant.

The native canoes are of excellent, though simple, construction, and I was anxious to purchase one for use in surface-dredging; but up to the present it has been impossible to do so, since the natives will only accept native shell-money[4] (dewarra or tambu) in payment. It is very difficult for white men to get hold of any of this dewarra. Gold will not tempt the natives to part with it. And, indeed, unless one is willing to purchase it from traders at the rate of three shillings a fathom, the only way to obtain it is by attending the funerals of chiefs and great men. This is, however, rather a tedious process, as we found on one occasion, when Mr. Parkinson and I attended the funeral of a man called Tononat, the son of a former great chief. We had to wait seven continuous hours before the dewarra was distributed.[5] During this time the women were wailing, the men were

[3] *Cf.* "Im Bismarck Archipel. Ergebnisse und Beobachtungen auf der Insel Neu-Pommern (Neu-Britannien)." Leipzig: 1887. Also "Album von Papua-Typen," in conjunction with A. B. Meyer, Dresden (Stengel and Markert), 1894. In this work the photographic reproductions are of surpassing excellence.

[4] The shells are the small *Nassa callosa* var. *camelus* v. Martens. (See Dr. O. Finsch). "Ethnologische Erfahrungen aus der Südsee." Wien: 1893. P. 387.

[5] The distribution of dewarra which occurs at the funeral of a rich man, among all the men who are, as it were, in at the death, is a remarkable spectacle. On the above occasion the amount of dewarra thus disbursed would correspond roughly to £150 sterling.

decorating, painting, and pouring sand and ashes on the body, and all were chewing the betel. After the body had been laid in the grave, I, for my part, received a fathom and a half of dewarra. The price of a canoe is 20 fathoms.

Before speaking of the Nautilus I may record the occurrence of a Tornaria in Blanche Bay. I have also found metamorphosing larvæ of *Balanoglossus*, but cannot say whether they and the Tornaria belong to the same cycle of development. The small Heteropod, *Atlanta*, is very abundant, but, while those dredged from the surface are sluggish and usually retracted in their shells, those dredged from a depth of 20 to 30 fathoms are as active and brisk as possible.

The native name of the Nautilus in the Gazelle Peninsula is "pal-a-lialia."[6] It is found in Blanche Bay at a depth of more than 70 fathoms, and is caught in large barrel-shaped baskets made of bamboo slips bound together by rattan, and provided with an internal basket-work which serves as a trap (see vignette at end). These fish-baskets are baited by suspending a number of small, smooth-skinned fish, called "malabur," inside. We obtain the malabur by exploding a charge of dynamite in the midst of a shoal of the fish. The baited baskets are lowered to the bottom after sunset and left there for several hours, when they are hauled up and may, or may not, contain several individuals. Often as many as six are obtained in one haul, and if several canoes are engaged in the fishing it is possible to secure some two dozen individuals in one night.

I will now give a brief summary of the observations I have so far made on *N. pompilius*.

1. *Mode of Occurrence.*—The Nautilus occurs in Blanche Bay throughout the season of the north-west monsoon, and this is already a fact of some importance, since it is thereby available for investigation the whole year round [and not merely during the S.E. monsoon]. The specimen on which Owen founded his classical memoir was obtained by Bennett off the New Hebrides in the month of August, *i.e.*, in the south-east season.

In the laboratory book at Buitenzorg there is an entry, made by Semon in 1893, containing the following statement referring to the Molluccas:—"Nach übereinstimmender Aussage alter Fischerdort, ist das Meer während der Zeit des S. O. Mons. (Mai–October) sehr viel tierreicher als in der des N.W. Mons. Nautilus wird beinah ausschliesslich nur in ersterer Jahreszeit gefangen (geangelt)." Further, in response to an inquiry as to the occurrence of the Nautilus at the Philippine Islands, the necessity of going there at the right time of the year, viz., April to July, was strongly impressed upon me by Dr. D. C. Worcester, of the University of Michigan.

[6] "Pal" means a "house," and "lia" means "above" or "beyond," so that "pal-a-lialia" signifies "house above house," and evidently refers to the chambered structure of the shell.

I have myself not yet seen the Nautilus swimming at the surface of the sea, all my specimens having come from the bottom.

2. *Nature and Temperature of the Sea-bottom in Blanche Bay.*—I have dredged in Blanche Bay in nearly all directions with the assistance of a small steam launch which I hired for the purpose, and everywhere, apart from the reefs which occur here and there near the shore, have found the bottom to consist of firm mud (which at some points is consolidated to a clay) and loose pumice-stones. This, then, is the feeding-ground of the Nautilus. I have not yet ascertained whether it is also the breeding-ground.

The temperature at the bottom, as found by attaching a deep-sea thermometer (kindly lent by Mr. Parkinson) to a fish-basket, is between 19 and 20° Celsius. This means that there is a difference of some 10° C. between the water in which the Nautilus lives and that into which it is brought when hauled up to the surface, and may account, in some measure, for the difficulty in keeping it alive for any length of time.

3. *Food.*—When a Nautilus, which has been taken in the fish-basket, is examined, the stomach, or crop, is found to be filled to its utmost capacity with fragments of the small fish used as bait. Among these are fragments of small Decapod Crustacea (probably Caridida), and it is probable that the latter form its chief article of food under ordinary circumstances, since they also come up, sometimes in large numbers, in the fish-baskets, and I have seen the Nautilus attack and swallow them. Owen also found Crustacean remains in the stomach of his specimen. It would seem as though they would prefer soft-bodied fish if only they could catch them. Dr. Woodford informed me by letter that in the Philippines the baskets in which the Nautili are caught are baited with pieces of raw chicken.

Nautilus itself affords very good eating. Not one that I capture is wasted. The taste is very much like that of other Cephalopods, and the toughness is between that of a young squid and an old octopus.

4. *Young Individual.*—The youngest individual that I have as yet obtained was a male with the following dimensions:—

Length from root of siphuncle to mid-anterior point of hood (measured along the dorsum)	25 mm.
Length of hood in middle line...	10·5 „
Breadth of body across middle of eyes ...	15 „

The surface of the hood was perfectly white and unpigmented. The branchiæ of opposite sides were in close apposition in the median line, and, curiously enough, the larger posterior pair extended forwards far into the interior of the funnel.

The shell was perforated at the umbilicus, as it is throughout life in *N. umbilicatus*.

5.—*Relations of male and female* (*N. pompilius*).—Out of sixty-seven individuals, fifty-one were male and sixteen female, so that the

statement in Pelseneer's recent "Introduction à l'étude des Mollusques," that "hyperpolygynie" occurs with the Nautilus, requires modification.

Most of the females that I have obtained have been immature, whereas many of the males have been mature, and have had spermatophores in the Needhamian vesicle and motile spermatozoa in the testis, and, in rarer instances, I have found a spermatophore in

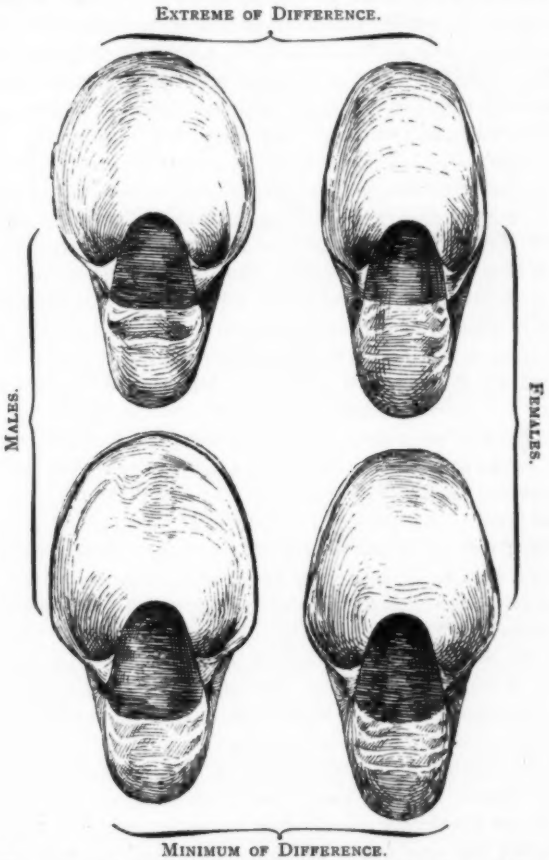

Fig. 1. Secondary sexual characters in shells of *Nautilus pompilius*.

the angle formed by the buccal mass with the dorsal hood, attached to the innermost tentacles of the inner lobes of the cephalic tentacular system, as first described by Van der Hoeven. There are reasons for thinking with Van der Hoeven that the spermatophore remains here for a long time.

Van der Hoeven and Keferstein describe a difference in the dimensions of the hood in male and female. I have made a large

number of measurements of the shells to ascertain if there was any constant difference between male and female. The male shells average larger than the females, but there is an astonishing amount of variation in the proportional dimensions of the shells of both sexes, into which, however, I need not now enter. The essential differences between the male and female shells will be seen clearly in the accompanying figures (Fig. 1), which are pen-and-ink tracings from photographs kindly taken for me by Mr. Parkinson. In most adults the shell can be readily identified as belonging to male or female, but often the identification is very difficult, and in young shells impossible.

The shell also varies to a great degree in thickness, being sometimes so thin that the slightest touch is almost sufficient to break it at the free edge, and in other cases as thick as cardboard.

6. *Significance of the so-called post-anal or supra-anal papilla.*—This curious structure, which immediately strikes the eye on drawing back the mantle, lies in the wall of the mantle across the middle line, immediately behind[7] the region of the renal sacs and, in the female, between that region and the nidamental gland.[8] It is identical in the two sexes. Hitherto this has been of unknown insignificance, but I have no hesitation in suggesting that it represents a pair of osphradia or branchial sense organs, corresponding metamerically with the pair described by Lankester and Bourne, between the bases of the gill plumes. This conclusion rests at present on two main grounds, namely, (1) Variation and (2) Relation to visceral nerves.

As to the innervation, I will say at once that it is very difficult to see the actual nerves or nerve-fibres (because the nerves are often not compact trunks, but broken up into loose strands) which pass into the osphradia; but the anatomical relations of the visceral nerves to the osphradia, which, I think, have never been fully described, are such as to leave no doubt as to the source from which the osphradia derive their innervation.

In the first place, one readily sees in fresh specimens that we have not to do with one papilla, but with a pair of papillæ, which are more or less deeply bifid or cleft at their free projecting extremities, and so approximated to one another in the middle line as generally to be fused together, but always with a deeper or shallower groove between them. In two examples, I have observed that the two papillæ were absolutely independent of one another, and separated by an interval (in one case, which I measured) of two and a half millimetres. (*Cf.* Fig. 2.)

Secondly, there are two main visceral nerves on each side, which run side by side in the wall of the vena cava immediately below the skin. On arriving at the region of the renal sacs, the two nerves separate, one of them, the outer and larger, proceeding to the branchiæ,

[7] That is when regarded with the mantle drawn back.

[8] In the fresh condition the nidamental gland is of a bright yellow colour.

and dividing into two shortly before reaching the osphradium of Lankester and Bourne, to which I am confident of having traced a small nerve, arising from the point of bifurcation.[9] The inner and smaller visceral nerve passes over the region of the renal sacs on each side to the base of what I may call the posterior osphradia (os^2), to which it undoubtedly sends nerve-fibres, although I cannot say positively that I have definitely traced these. In the

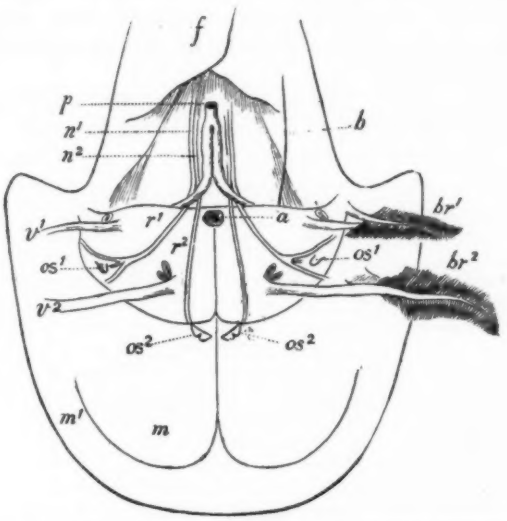

Fig. 2. Dissection of the Pallial cavity of *Nautilus pompilius*.

f. Funnel. *b*. Bristle passed into aperture of left rudimentary genital duct. *p*. Male genital aperture. *a*. Anus. *m*. Mantle reflected back. m^1. Muscular margin of mantle. n^1,n^2. Visceral nerves showing through the skin. br^1,br^2. The branchiæ. v^1,v^2. Branchial veins. r^1,r^2. Region of anterior and posterior renal sacs. The excretory granules with which the latter are usually filled produce a brilliant vermilion colour in the fresh condition. os^1,os^2. Osphradia.

N.B.—os^2 = post-anal papilla; in this example its two component papillæ were separated by an interval of $2\frac{1}{2}$ millimetres. A line drawn from the anterior renal opening to the posterior osphradium (os^2) will pass over the posterior renal opening. The inner and larger of the two posterior openings on each side is the viscero-pericardial aperture.

female, I have followed the main trunk of this nerve through the nidamental gland. The two visceral nerves on each side arise close together from the visceral ganglion[10] (posterior subœsophageal ganglion of Owen).

Finally, one can see from the accompanying figure that the two papillæ, discussed above, have essentially the same topographical

[9] As it crosses the renal sacs, the outer visceral nerve runs along the line dividing the outer anterior sac from the inner posterior sac.

[10] The figure of the visceral nerves given by Keferstein corresponds more to what I have found than does that of Owen.

relation to the posterior branchiæ that the osphradia of Lankester and Bourne have to the anterior branchiæ. Their greater proximity to the middle line is shared in common with the posterior renal sacs and renal apertures, and even the posterior branchial veins, as compared with the corresponding anterior structures.

That they are bifid and, therefore, more highly developed than the anterior osphradia,[11] is in keeping with their position in the living Nautilus in the anterior region of the mantle cavity, and also with the fact that the posterior branchiæ, with which they would be associated in the metameric system, are considerably larger than the anterior branchiæ.

I remain, dear Professor Lankester,

Ralum, New Britain, Yours very truly,
February 10, 1895. ARTHUR WILLEY.

[11] It must be remembered that the terms anterior and posterior as used above refer to the reflected position of the mantle and not to the actual position in the living animal.

SOME NEW BOOKS.

The Text-book Writer among the Echinoderms.

Lehrbuch der Vergleichenden Anatomie . . . Vierte Abtheilung. Vergleichende Anatomie der Echinodermen und Enteropneusten. By Dr. Arnold Lang. 8vo. Pp. xvi., 871–1198, 251 text figures. Jena: G. Fischer, 1894. Price, 7 marks.

As a condensed account of the morphology of the Echinoderma, this should prove a useful compilation, and one cannot but admire the assiduity of the compiler. But it is a compilation and little more. One has not to read many paragraphs before becoming aware that the writer is no specialist in this subject. From one point of view, this may be thought an advantage; from another it is certainly a disadvantage. The author of a text-book such as this should combine the learning of the specialist with the wide outlook and broad grasp of the philosophical biologist. The demand, however, is, at least at the present day, an impossible one. It can never be stated too often or too strongly that the single author text-book, on any such extended scale, is foredoomed to failure. The specialist in each branch knows how many years it takes him to grasp the rudiments of his subject, and he simply laughs at the idea of any man, even so clever a man as this eminent Swiss investigator and professor, venturing to collect and retail the knowledge of all the groups of the Invertebrata which has been and is being laboriously acquired by a multitude of scattered workers.

It seems, however, inevitable that such a book as this, devoting as it does 284 pages to a single group of animals, the Echinoderma, should be criticised from the standpoint of the specialist. It is all very well for the student to say that he understands a certain book, and reads it with pleasure, or for the philosopher to admire the masterly handling of facts and theories; but what if your expert comes along the next minute and says—as he alone has a right to do—that the language is incorrect, the very facts wrong, and the theories those of the day before yesterday? I propose, therefore, to deal with this book from such vantage ground as I may have gained by several years study of some of the animals dealt with in its pages; and, though such a proceeding may seem rather unfair to the author, it is surely fairer to the public, and, in the long run, of more use to the author. It may also advantage specialists themselves. For, if specialists write in such a way that an acute observer and able writer cannot render their views correctly, then it is just possible that some of the fault may lie with the specialists and not with the compiler.

The class to which I propose chiefly to direct attention is that of the Crinoidea. These, it must be admitted, are remarkably difficult animals to study, and the difficulty is enhanced by the fact that so many, and those the more important, are found only in the fossil state. One can but sympathise with the poor man who undertakes,

in a fraction of two or three years, to master the problems presented by the literature alone. It is not surprising that the writer of this book has repeated a few errors that seem to be the common property of text-books. It will be well to correct these at some length, and with the lucidity that must hitherto have been lacking in our attempts.

First, we find this lamentable confusion between the dorso-central and centrodorsal, as well as a misconception of the true meaning of the latter. It may be granted willingly that the two terms are very similar, and that it was quite wicked of anybody ever to give such similar names to two distinct elements of the crinoid skeleton; but this does not alter the fact that the elements are distinct. The confusion occurs in the following sentences. On p. 904 it is written, "In the apical system [of the Echinoderma] the following plates occur: (1) a central plate at the apical pole; (2) a circlet of five radially-placed plates, the Infrabasals," etc. From p. 888 we learn, quite correctly, that this central apical plate is called the "Dorsocentral." On p. 915 follows this remarkable statement: "A central plate has been observed in the larva of *Antedon*. Later on it fuses with the uppermost ossicle of the larval stem, which supports the calyx, and with the infrabasals, to form the Centro-dorsal." That is to say, according to Dr. Lang, the dorsocentral forms part of the centrodorsal. The facts are simple; they are not as above stated, but they are as follow. The plate in the *Antedon* larva, to which the name "dorsocentral" has been applied, lies at the distal or aboral end of the stem, and differs from the other calcareous elements of the stem in being larger and flatter. It is by this plate that the so-called "pentacrinoid" larva becomes attached. When the larva begins to assume the characters of the adult *Antedon*, the proximal ossicle of the stem, nearest the calyx, increases in thickness, and develops first one, then two and three, whorls of cirri; it also becomes fused, as is now known, with the remains of the infra-basals. The *Antedon* eventually breaks away from its stem, carrying with it only this proximal, cirrus-bearing ossicle; and it is to this ossicle that the name "centrodorsal" is properly restricted. It is obvious, then, that the dorsocentral has been left behind in the place to which it became attached, and that it has no part or lot in the centrodorsal.

The centrodorsal is considered to represent more than one stem-ossicle, as has been most clearly put by Ludwig (Zur Anatomie des Rhizocrinus Lofotensis; *Zeitschr. f. wiss. Zool.* xxix., p. 73, 1877): "The centrodorsal is a compressed upper portion of the stem, in which the calcified tissue has undergone no separation into ossicles lying one under the other." The fact that the infrabasals become fused to this structure is interesting, but cannot be considered to conflict with the statement of Ludwig—that is to say, this morphological element would remain a centrodorsal even if the infrabasals did not become so fused; indeed, it is possible that they were not so fused in many of the earlier Antedonidæ. The fact that the centrodorsal bears whorls of cirri is, however, very characteristic, for it is chiefly this fact that shows it to be a compound structure and not one simple stem-ossicle. The early stages in the evolution of a centrodorsal may be seen in *Millericrinus Pratti*, as described by P. H. Carpenter (*Quart. Jour. Geol. Soc.*, vol. xxxviii., p. 21), and in *Thiollericrinus* (De Loriol: "Faune jurassique du Portugal"), and this palæontological evidence confirms the view that the centrodorsal is a compound structure. Essentially it is a part of the stem, and though it may, in certain cases, become fused with some elements of the calyx, it

cannot in a morphological sense be said to form a part of the calyx or to have anything to do with the apical system of plates. The greater or less extension of the lobes of the chambered organ below the actual limits of the calyx has nothing whatever to do with a centrodorsal, and is of no morphological importance. Such is the conception of the centrodorsal as we receive it from the most eminent writers on the Crinoidea—Wyville Thomson, the two Carpenters, De Loriol, and Ludwig. It is, therefore, incorrect and misleading of Dr. Lang to say (p. 897) that the expanded centrodorsal forms part of the calyx of Apiocrinidæ, or (p. 898) that there is a centrodorsal in the calyx of the Bourgueticrinidæ. The structure to which he is here alluding is the proximal stem-ossicle, and it is not a centrodorsal in any sense of the term, although that name has occasionally been applied to it by the compilers of text-books.

Let me add a word on my own account as to the dorsocentral. Dr. Lang cannot be blamed for considering some plate with this name to be an essential element of the echinoderm apical system, since he is merely following the highest authorities, among whom may be mentioned Loven, P. H. Carpenter, and Sladen. Personally, I have long considered this plate to be, like the now abandoned orocentral, no more than a myth of transcendental morphology. On purely palæontological grounds, and specially from a consideration of the Cystidea, I have found it impossible to swallow the extended homologies that have been maintained, chiefly by the writers just named, between the apical systems of the various orders of Echinoderma. This, however, is a vast question, only to be settled by reference to decided facts, too many to be dealt with here. But, so far as the dorsocentral is concerned, the following facts may be recalled to mind. In the whole of the Crinoidea, Cystidea, and Blastoidea, the actual existence of such a plate is known only in the embryo *Antedon* and the adult *Uintacrinus* and *Marsupites*. Indeed, even *Marsupites* should probably be set on one side, for it is quite open to us to believe, as Seeliger for one does believe, that the central apical plate of this genus is merely the top segment of a stem, a legacy from stalked ancestors which has become modified and incorporated in the calyx wall. If this plate were a true centrodorsal, that is, if it bore cirri, the question would be settled; but the absence of cirri does not necessarily prevent it being derived from one or more stem-ossicles. Unfortunately, in the picture of ancient crinoids that present knowledge permits us to call up, *Marsupites* is a kind of Mahomet's coffin hanging between heaven and hell; just as it seems to have no descendant, so also it has no visible ancestry. In this inquiry, then, it offers no evidence worth attention. The plate in *Uintacrinus* may likewise be a stem-ossicle, or it may represent fused infrabasals. The belief in a crinoid dorsocentral must, therefore, rest on the facts of development in *Antedon*. Here it should be remembered that the ascription of this plate to the apical system of the calyx is a pure assumption; at least, I cannot find that anyone has ever seen it forming a part of the calyx. When it is first seen it is already separated from the calyx by a varying number of columnals, and, at this early period, the basals and orals, which are the only calycal plates yet formed, are still remote from one another and unsymmetrically disposed. There is, in short, no evidence to show that this plate ever lay at the apical pole symmetrically surrounded by the five basals. By those who regard it as a calycal element some weight is attached to its shape and structure, so different from those of the developing columnals. But

many stalked crinoids present an expanded base of attachment, often involving more than one columnal. Such a structure, inherited from ancestors, still of functional importance, and specially necessary in all cases during larval life, would surely not be developed in precisely the same way as an ordinary columnal. Such considerations, it is true, would not be enough to upset the theory of a dorsocentral, were any evidence in its favour forthcoming; but, in the absence of such evidence, they are enough to suggest caution in the acceptance of far-fetched homologies. The foregoing conclusions were based, as stated, chiefly on palæontological grounds, and were opposed to the views of those who laid more stress on embryology. But now even an embryologist has struck a severe blow at the generally received homologies. Mr. MacBride states (*Proc. Roy. Soc.*, vol. liv., p. 433) that in *Asterina* as in *Antedon*, the præ-oral lobe of the larva becomes a fixing organ or stalk, but the relations of this stalk to the body of the adult are totally different in the two cases. "It follows that *the abactinal poles of* Asterina *and* Comatula (Antedon) *are not comparable with each other*, and that all conclusions based on the supposed homology of the dorsocentral in Echinids and Asterids, and that in Crinoids, are incorrect." Of course if this be so, not merely are the conclusions to which Mr. MacBride refers untenable, but the last support of the dorsocentral itself is also demolished. The dorso-central, considered as a morphological element of the Echinoderm type, has got to go.

To return to Dr. Lang, a similar error in the use of terms occurs in his treatment of the perisomatic skeleton. On p. 923 this is defined as composed of all those skeletal pieces which protect the body between the apical and oral systems. Further, in the Crinoidea (p. 949) the perisomatic skeleton is said to consist of (1) the perisomatic skeleton of the calyx; (2) the skeleton of the arms and pinnules; (3) the skeleton of the stem. And in the perisomatic skeleton of the calyx are included all skeletal pieces other than the dorsocentral, infrabasals, basals, radials, and orals.

Now the term perisomatic skeleton appears to have been first employed by Sir Wyville Thomson in his paper, "On the Embryogeny of *Antedon rosaceus*" (*Phil. Trans.* 1865, p. 540) in these words: "The skeleton of the pentacrinoid is composed of two systems of plates, which I shall term respectively the *radial* and the *perisomatic* system, thoroughly distinct in their structure and mode of growth. The radial system consists of the joints of the stem, the centrodorsal plate, the radial plates, and the joints of the arms (and subsequently of the pinnules). The perisomatic system includes the basal and oral plates, the anal plate, the interradial plates, and any other plates or spicula which may be developed in the perisom of the cup or disk." The lateral and covering plates of the ambulacral grooves were likewise included by Sir Wyville in his perisomatic system. Precisely the same significance was attached to the term by subsequent writers on the Crinoidea, at least down to and including the "Challenger" reports of P. H. Carpenter. In their important paper, "The Perisomic Plates of the Crinoids" (*Proc. Ac. Nat. Sci., Philadelphia*, 1890, p. 345), Messrs. Wachsmuth & Springer seem to have used the term in a different sense, or rather they substituted for the old division one that is simpler and, to my mind, more logical. They divide the skeletal elements of a crinoid into *primary* and *secondary*. *Primary* elements include: (*a*) The abactinal plates, developed on the right antimere and connected with the axial nerve-cords, viz., columnals, infrabasals, basals, radials, and all brachials; and (*b*) the actinal

plates, developed on the left antimere and connected with the mouth, viz., orals and all plates of the ambulacra. The *secondary* or *supplementary* elements are all the interradial, interbrachial, and interambulacral plates, including the anal plates and those of the tube or sac. It is, apparently, to these secondary plates that Wachsmuth and Springer restrict the term perisomic.

It is, then, perfectly clear that Dr. Lang's definition is something quite new; and he ought, therefore, to have said as much, and to have given the grounds on which it was based. What those grounds may be I am at a loss to discover: to include brachials and interbrachials under one head seems a hopeless confusion. However advisable it may be to discriminate between the supposed primitive apical and oral systems on the one hand, and the supposed newer additions on the other, it must always remain unjustifiable to wrest the word perisomatic from its original and usual meaning. It seemed possible that Dr. Lang might have been influenced by the use of the word in other orders of the Echinoderma; but it does not appear that even there the word is used (or, if used, properly used) in the sense here attached to it. Huxley, in "A Manual of the Anatomy of Invertebrated Animals," 1877, uses "perisoma" in its obvious sense for the general body wall of Echinoderma; but he does not use the words "perisomic" or "perisomatic," and does not differentiate the skeletal elements. In its simplest meaning, derived from the foregoing simple meaning of "perisoma," the word "perisomatic" would naturally be applied to the skeleton of the body-wall as opposed to that occasionally deposited in the viscera; but this would bring us no nearer Dr. Lang's use of the term. In no other of the standard textbooks is the word used in any such sense, and it, therefore, seems right to raise an immediate protest. For my own part, I should prefer to drop the term altogether.

It was hardly to be expected that the difficulties that have been introduced into the study of crinoid arms by many generations of writers should have been entirely mastered by Dr. Lang. He is correct in discriminating the primary brachials, which are purely arm structures, from the radials, which belong to the apical system. He also points out very clearly how certain brachials may become included, as fixed brachials, in the limits of the dorsal cup, and yet remain morphologically part of the arms. He does not, however, bring out with similar clearness the fact that the number of arms in every crinoid, with a few well-known exceptions, is five, and that any apparently greater number is produced solely by the branching of these five arms. Had this been clear to the writer's mind, he would not have wasted space in repeating the fact that there are five arms in *Thaumatocrinus*, five in the Bourgueticrinidæ, and so on; nor would he have spoken of "ten pairs of arms" in the Eucalyptocrinidæ when he meant ten pairs of arm-branches; nor would he have said "arms usually branched" in the Apiocrinidæ, since they are, if I remember rightly, always branched, though sometimes only once.

There is a similar hesitancy in the various references to pinnules. It is suggested, with undoubted correctness, that "the pinnules are best regarded as the ultimate arm-branches"; but had the author really understood what this sentence implied, he could not have written, "pinnules appear to be absent" in *Crotalocrinus*. It is no question of appearance: pinnules simply could not be present, any more than the most angelic of us could sprout wings.

This confusion extends to the description of the covering-plates of the arms. These are minute plates developed on either side of

the food-groove, both in arms and pinnules. They vary considerably in the extent of their development; but they occur in almost all crinoids, and the species in which they are so atrophied as to be indistinguishable are very few indeed. They close over the food-groove, so as to protect its delicate ciliated lining from mud or other destructive agents; but during active life they are kept open. They are more highly developed in many of the Palæozoic crinoids than in those of our own day, and are, in some of the former, very complicated structures; but even here there is evidence that they could be opened. I have myself figured specimens of *Botryocrinus* from the Wenlock limestone preserved with the covering-plates erect, which is direct evidence, and I have demonstrated in *Cyathocrini* from Gotland the presence of an articular facet and apparent innervation from the axial nerve-cords, which is indirect evidence. Consequently, Dr. Lang is speaking far less than the truth when (on p. 890) he refers to the Inadunata as possessing covering-plates, which "could probably be erected," in non-pinnulate arms alone; or when (on p. 960) he speaks of covering-plates in the past tense only, and of their absence as quite a common occurrence.

The section on the Mode of Union between the skeletal pieces (pp. 964, 965), betrays a hopeless confusion, perhaps pardonable considering the difficulty of the subject. The first mode of union is thus described. "Two plates are firmly and immovably joined. There is no fibrous connection between them; between the two plates is an unbroken deposit of calcareous substance, which, however, is less solid than that of the plates themselves." So far, so good; this is a fair enough description of fusion or ankylosis, such as obtains between the basals of *Bathycrinus* or the radials of *Rhizocrinus*. But mark how our author proceeds! "In this way all or some of the plates of the cup are frequently united, *e.g.*, the radials of *Antedon* with one another and with the centrodorsal. Such a union is called a suture or synostosis." This is entirely incorrect. The term "suture" is a general one, which may be applied to every mode of union short of muscular articulation. The union above described is an ankylosis, not a synostosis. The radials of *Antedon* are not united in this way, but are united by "synostosis," or Close Suture, as Carpenter, Wachsmuth and Springer, and myself subsequently preferred to call it. In a close suture (I quote P. H. Carpenter) the skeletal elements are united "by means of connective tissue fibres, which pass from the . . . organic basis of the one joint into that of the other. These fibres are sometimes quite short, and their ends are surrounded by the denser layers of calcareous reticulation on the apposed surfaces of the two joints, which are thus closely and immovably fitted together, though they can be separated by the action of alkalies." This kind of suture is probably that which Dr. Lang had in his mind when he penned his next paragraph, in which he erroneously calls it a Syzygy. It is true that a syzygy is a form of close suture; but it is untrue that "all or most of the ossicles of the stem are united by syzygial sutures," that "syzygial sutures may occur in the cup," or that "the occurrence of syzygial sutures in a series of ossicles renders a certain flexibility possible." The term "syzygy" was invented by Johannes Müller, and by him applied to that particular case of close suture between two brachials in which the proximal or lower of the two loses its pinnule (supposing pinnules to occur). The term has since been extended to the precisely parallel case of close suture between two columnals, in which the lower of the two loses its cirri (supposing cirri to occur on all columnals), while the upper still bears them. The

two components of a syzygy are termed "epizygal" and "hypozygal." The next stage to the close suture is the Loose Suture. This is either overlooked by Dr. Lang, or has been confused by him with his "syzygy." In the loose suture the two elements are connected by fibres, as in the close suture; but the connection is more elastic and flexible, and there is a more or less developed facet cut out of the edge of the plate, or else a system of ridges or striæ. Finally comes the Muscular Articulation, which receives a nerve supply from the apical, aboral nerve centre. This is correctly described by Dr. Lang, though he is wrong in saying that "all ossicles of the pinnules [in living crinoids] are united by a muscle-joint." Most are united by loose suture. It is also misleading to say that "where the costals [*i.e.*, primary brachials] are incorporated in the cup, a certain flexibility of the calycal skeleton is the consequence." This is true for the Articulata (*Taxocrinus*, *Ichthyocrinus*, and allies); but it is quite untrue for the typical Camerata (*Actinocrinus* and allies). Flexibility between the plates of the cup is, where it occurs, an independent development, and has nothing to do with the incorporation of brachials; it is found even in some species of Inadunata, where, of course, no brachials enter into the cup.

Naturally it is difficult to draw hard and fast lines between these various modes of union; and it is a vain attempt of this kind that has made the subject more puzzling than it need be. On this point Dr. Lang holds a rational opinion, and exercises due caution. Perhaps the whole matter may be most conveniently stated in the historical or evolutionary method. The plates of Echinoderma are deposited in a stroma of connective tissue fibrils, any of which may, as occasion arises, assume muscularity. It is reasonable to suppose that the skeleton, either in each group or in an ancestral stock, developed from scattered spicules like those of most modern holothurians. This does not mean that such holothurians are necessarily primitive, nor is the evolution of radial symmetry, pentamerous or otherwise, now in question. Spicules grew into plates or ossicles; and these were at first united loosely by the connective tissue fibrils, as yet undifferentiated into special muscles: this first stage was the Loose Suture. From this the development proceeded in opposite directions. One, in the direction of greater fixity, through the Close Suture or Synostosis, with its special case—the Syzygy, to the Ankylosis. The other, in the direction of greater flexibility and voluntary motion, through the Imperforate Articulation to the Perforate Articulation with its axial nerve-cords, its highly developed muscles, teeth, and ligaments. Since there is no essential difference between any of these modes of union, it has always been possible, as fossils give instance, for a close suture to pass back again through the loose suture to a stage almost worthy the name of articulation. The stem of a crinoid, for example, presents us with instances of ankylosis, close suture, syzygy, loose suture, and complete articulation, each, as need arises, developed independently from the loose suture, which is the normal type.

The remaining chapters, which deal with the morphology of the other systems and organs of the body, and with embryology, ontogeny, and phylogeny, appear to present a remarkably exhaustive digest of our knowledge, so far as recent crinoids go, well up to date, and interspersed with critical suggestions of some value. Exception, however, has rightly been taken by previous critics to the omission of the names of authorities. One does not necessarily want a historical sketch; but the value of some of the paragraphs would be greatly enhanced if one could tell on whose authority certain statements or

opinions were given; and this might have been rendered possible by the insertion of a name here and there between brackets. For instance, in chapter xx., on Regeneration and Asexual Reproduction, it is stated that "In Ophiurids regeneration of the whole body from one arm never occurs." Has Dr. Lang considered Semon's case of *Ophiopsila aranea* (*Jena. Zeitschr.*, xxix., p. 585), and has he rejected it? We cannot tell. In the same chapter it is doubted whether "Division of the body into two nearly equal halves with subsequent regeneration" has been observed in Holothurians. Does Dr. Lang doubt the observations of Chadwick (see NATURAL SCIENCE, vol. v., p. 4), or is he ignorant of them? We cannot tell. Was the cautious paragraph on autotomy in crinoids written before or after Dr. Lang had read the interesting account given by Danielssen and quoted in NATURAL SCIENCE (vol. v., p. 5)? We cannot tell.

In his account of the development of *Antedon*, Dr. Lang has followed Seeliger throughout, as the student may for this once gather from the figures. I am glad to find him criticising the expression "Cystid stage," in so far as it implies any recapitulation or morphological affinity; but I must protest against his falling into a precisely similar error in his next section. He says, with all the emphasis of spaced type, that in the pentacrinoid stage "the correspondence of the attached and stalked larva of *Antedon* with the Inadunata, especially with the so-called Larviformia, is quite remarkable, immediately striking the eye." With equal emphasis I deny that any except a superficial resemblance exists. The stem is totally different: the base is, we know, dicyclic; in nearly all so-called Larviformia it is monocyclic: the radials and basals are quite regular; in most Larviformia they are more or less irregular, owing to the bisection of some radials: the arms are branched; in the Larviformia they are single: the temporary anal plate, though no doubt homologous with that occurring in some Larviformia, is not comparable in situation or course of development. In short, Professor Lang's emphatic dictum is a typical example of those rash and inexact comparisons that drew so just and vigorous a protest from Professor von Zittel in his address to the Geological Congress (NATURAL SCIENCE, vol. vi., p. 308).

Adequately to discuss the chapter on Phylogeny would require a special article, though it deals only with the origin of the Echinoderma and the relations of the classes. A primitive bilateral form, corresponding to the Dipleurula larva, is sketched out. Since radiate structure is a consequence of an attached mode of life, "all echinoderms must once have been attached animals." Attachment took place by the anterior end of the body (larval organ, præ-oral lobe). "The body then developed chiefly in the region of the mouth and tentacles. The hind part with the anus was at first a lateral projection, which gradually subsided and less and less disturbed the radiate arrangement. On this view the greater extension of the anal interradius, found especially in palæozoic crinoids, may possibly be an original condition, with which is connected the occurrence of special anal plates in that interradius." Here, again, the facts of phylogenetic development, as deduced from actual fossils and not from imaginary archetypes, force me to join issue with Dr. Lang. Granting the lateral position of the anus, the evidence, at all events of the Inadunata, shows that the widening of the anal interradius and intercalation of anal plates was a secondary condition, of which the initial rise can be traced just as easily as its final decline.

This attached stage has been persisted in by the Crinoidea, although many genera have, at different periods, relinquished it for a

free mode of life. Other classes relinquished it at an earlier period in their history, and of these the Holothurians, says Dr. Lang, were the first to become free. They remained attached, however, long enough for five food-grooves with their rows of tentacles to be developed. But as the various classes became free, and took in food directly by the mouth, these food-grooves gave up their original function, and they with their underlying nerves became transformed into the subepithelial radial nerves with their epineural canals. I myself suggested, in 1889, that while radiate symmetry was, in the case of Echinoderma, due to fixation, the special case of pentamerous symmetry was induced by its mechanical superiority to the tetramerous or hexamerous type, and that pentamerism in Holothurians might be due to the fact that they were descended from ancestors in which the typical skeleton was better developed (*Quart. Journ. Geol. Soc.* xlv., p. 166). It is interesting to find that Dr. Lang is brought by his views to a similar suggestion. Or is he adopting mine? We cannot tell.

It is, however, impossible to agree with Dr. Lang that the ancestor (Stammform) of the Crinoids had a determined composition of the dorsal cup, viz., five infrabasals, five basals, five radials, and the anals. Either there were two ancestral types, one with infrabasals, the other without; or the dicyclic type was derived from the monocyclic by a modification of the cup-plates. In either case, the anals were a secondary development.

From such an attached "Crinoid-phantom," as the Sarasins would call it, Dr. Lang derives the Echinoids, Ophiurids, and Asteroids. His belief that the Echinoids are descended from attached ancestral forms with arms is due to the fact that the gonads have become influenced by the pentamerism, and must, therefore, have originated as fertile outgrowths of the axial organ contained in arms. The Ophiurids branched off later still, and the Asteroids were last of all to adopt a free life, an idea confirmed by the temporary fixation of the larva still seen in their ontogeny.

These ingenious views present many difficulties, to some of which allusion has been made; but they are distinctly stimulating and worthy of careful study in the original. Fortunately, a translation of this book, by Mr. and Mrs. H. M. Bernard, is being published by Messrs. Macmillan, so that English students will soon have an opportunity of carefully considering Dr. Lang's ideas. Despite the slips to which I have thought it right to call attention, the book is a wonderful compendium of our knowledge of the Echinoderma, clearly written and beautifully illustrated. It concludes with a short but adequate account of the Enteropneusta, the larval forms of which have been shown by recent research to indicate some remote connection with the ancestral Echinoderm stem. F. A. BATHER.

THREE BOOKS ON BOTANY.

LEHRBUCH DER BOTANIK FÜR HOCHSCHULEN. Von Dr. Eduard Strasburger, Dr. Fritz Noll, Dr. Heinrich Schenck, Dr. A. F. W. Schimper. Gr. 8vo. Pp. vi., 558, with 577 illustrations. Jena: Gustav Fischer, 1894. Price 7 marks.

A STUDENT'S TEXT-BOOK OF BOTANY. By Sydney H. Vines, M.A., D.Sc., F.R.S. 8vo. Pp. xvi., 821, with 483 illustrations. London: Swan, Sonnenschein & Co., 1895. Price 15s.

A HAND-BOOK OF SYSTEMATIC BOTANY. By Dr. E. Warming, with a revision of the Fungi, by Dr. E. Knoblauch. Translated and edited by M. C. Potter, M.A., F.L.S. 8vo. Pp. xii., 620. London: Swan, Sonnenschein & Co., 1895. Price 15s.

How is it done? Here is a text-book of the first order, bearing the names of at least two of the best botanists in Germany, well printed and profusely illustrated, some of the figures being new, and all for the equivalent of seven shillings. Is the cost of production so much less in Germany; or is the publisher satisfied with less profit; or is it an advertisement for Bonn University, with which all the authors are connected?

A text-book is generally the work of one man, whose qualifications to speak with authority may be of very unequal value in the different branches. This difficulty is satisfactorily avoided in the present work. Professor Strasburger supplies the first section, "Morphology," including external form and internal structure. We could have no higher authority for this branch, and the 130 pages form an excellent introduction to the general facts of form and structure. The portion dealing with the cell and its contents is of special interest, embodying, as it does, so much of the writer's own work. Dr. Noll is responsible for the Physiology (pp. 132–256), which is a well-arranged general account of the life-processes in plants. We are surprised, however, to see the process of assimilation represented on p. 169 as consisting of the union of carbonic acid gas and water to form starch. This is scarcely in accordance with modern views. The second half of the book, "Special Botany," is divided between Dr. Schenck and Professor Schimper. The former deals with the Cryptogams (pp. 258–363), the latter with the Phanerogams (pp. 364–512). This systematic portion is very well illustrated, one feature being the indication of the common poisonous plants by coloured figures. But why are *Lolium temulentum* and *Vincetoxicum officinale* left uncoloured? The scheme of classification is similar to those generally adopted on the continent.

A translation of this work by Dr. A. C. Porter, assistant instructor in botany at the University of Pennsylvania, is to be issued by Messrs. Macmillan. We are glad that America and not England is concerned. The slavish adoption of continental text-books has gone quite far enough in our own country. We are well able to supply our own students with indigenous productions, as evidenced by the admirable hand-book which we now proceed to notice.

We have already reviewed the first half of Professor Vines' text-book, which appeared in January of last year, and are now glad to welcome the complete work. Dr. Vines' English edition of Prantl, which appeared fourteen years ago, has long been insufficient for the advanced student, who has been restricted to new editions of time-honoured but woefully out-of-date handbooks, or else forced to select from the excellent but somewhat too exhaustive German works of Sachs, Goebel, and De Bary, translations of which have been issued by the Oxford University Press. The second half of the book deals with the classification of flowering-plants and physiology. The introduction to the former is a most able account of the life-history of seed-plants, and is the fullest expression we have seen of the relation existing between these and the Pteridophyta. The scheme of classification resembles that adopted in Prantl and Vines' text-book, with slight differences. Among others we notice the insertion of many of the Monochlamydeous orders among the Polypetalæ, though the sub-class Monochlamydeæ is still kept up. A strange mistake occurs on p. 590, where the old-world *Balanophora* is described as a "Brazilian" genus. The section on Physiology (pp. 666–783) is an excellent sketch of the subject, but we expected a somewhat fuller treatment from Dr. Vines. For this, however, he will perhaps refer us to his

"Text-book on Physiology," of which we should be glad to see a new edition.

It is unfortunate that the English edition of Dr. Warming's excellent work on Systematic Botany should have appeared almost simultaneously with the completion of Dr. Vines' Text-book. In the latter the ordinary advanced student will find what he requires in Systematic Botany with the addition of Morphology and Physiology; while the Warming-Potter handbook is, to a great extent, a repetition of the portion dealing with classification only. The price of the smaller book is the same, and, for a translation, seems rather a heavy one. Many teachers as well as the higher class of students will, however, be glad to have the opportunity of reading a book which was inaccessible to them in the original Danish.

Recent tendencies in the arrangement of algæ are to lay continually less stress on colour grouping, and in Dr. Knoblauch's revision, presented to us here, we find them divided into ten classes, three only of which are Chlorophyceæ, Phæophyceæ, and Rhodophyceæ respectively. It is somewhat surprising to find the bacteria included as colourless algæ. The fungi fall into three classes: Phycomycetes, Mesomycetes—a small class including intermediate forms between the first and third, viz., the Hemiasci and Hemibasidii or Ustilagineæ, and the Mycomycetes or higher fungi, comprising Ascomycetes and Basidiomycetes. Lichens form appendices to each of the two latter sub-classes, according to the nature of the fungal element.

The Angiosperms occupy the larger half of the book (pp. 273–end), and here we find a departure from the methods adopted in English works, which are based on the system elaborated in the Genera Plantarum. Dr. Warming's aim was to get a scheme which should represent as nearly as possible the course of evolution of complicated and "derived" floral structures from the simplest forms. He therefore starts with the willows (Salicifloræ), where the male flower consists only of a few stamens and the female of a single ovary, and works up through the monochlamydeous and dichlamydeous polypetalous orders of Dicotyledons to the Sympetalæ, which culminate in the Compositæ. A careful study of the whole reveals the fact that we are still a long way from a phylogenetic classification, if, indeed, such is possible with the materials now in existence.

From a literary point of view the work is poor. It abounds in slovenly writing and bad spelling. Many of the illustrations will be new to the English student. These, however, have the effect of making some of the old familiar figures look rather worn.

The British Museum Catalogue of Mycetozoa.

A Monograph of the Mycetozoa, being a descriptive catalogue of the species in the herbarium of the British Museum. Illustrated with 78 plates and 51 woodcuts. By Arthur Lister, F.L.S. Printed by order of the Trustees, and sold by Longmans & Co., B. Quaritch, Dulau & Co., Kegan Paul & Co., and at the British Museum (Natural History), Cromwell Road. London. 1894. Pp. 224 and 78 plates. Price 15s.

The British Museum and the scientific public are indebted to Mr. Lister for more than this beautiful and careful monograph. Mr. Carruthers, in a preface, states that owing to the generosity of Mr. Lister, the national collection has been extended so as to include all the types described in this catalogue.

The slime-fungi have a very peculiar biological interest. While it is by no means certain that some of them, or all of them, may not be degenerate from higher forms of fungi, yet the majority of them

exhibit characters that suggest affinities with both the animal and vegetable kingdoms. Many persons see in them a hint of the primitive appearance of living matter. The life-history of a slime-fungus may be taken as beginning with a spore enclosed in a firm cell-wall. In suitable surroundings the cell-wall bursts and there creeps out a tiny "swarm-spore," a little naked mass of protoplasm with a contractile vacuole and a nucleus, and provided with a single flagellum or cilium. In this stage the little cell wriggles through the water, in its appearance and in its method of feeding being quite like an animal. In this stage, too, it multiplies rapidly by division. The numerous swarm-spores thus produced become amœboid; instead of being rowed through the water by the lashing movements of a cilium, they creep through it by the protrusion of pseudopodia. In this condition they are to be found chiefly where there are decaying, comparatively solid, masses of organic matter. The amœbæ fuse together, forming a plasmodium, in which the outlines of the original amœbæ sometimes remain visible, sometimes are lost. The whole plasmodium creeps about and exhibits streaming movements like a gigantic amœba. Such a plasmodium offers, from its size, many facilities for the investigation of protoplasm in the mass, and a number of remarkable experiments have been performed upon the plasmodia of various species showing the positive and negative attraction between the protoplasm and various chemical substances. Into these general biological questions Mr. Lister, of course, does not enter, as his monograph is chiefly systematic.

The plasmodium contains a number of nuclei, and these may multiply. After a time, especially when the substance upon which the plasmodium is creeping becomes dry, the process of spore-formation begins. The plasmodium comes to rest, and it either forms a single sporangium or divides into several portions, each of which forms a sporangium. The external wall hardens to form the wall of the sporangium, and the internal protoplasm breaks up into cells surrounding each of the nuclei. Each of these cells in turn forms a thick cell-wall and becomes a spore.

Among creatures so simple it is plain that the difficulty of establishing systematic criteria must be great. Indeed, in many respects the classification of them in the absence of an extended physiological examination of their habits and properties, their response to the stimulations of different media, and the results of such investigations as have been made upon bacteria, must remain rather an empirical index serving for their identification than a classification in the modern scientific sense. With such necessary limitations, Mr. Lister's system is very good; and all biologists who take an interest in this group must remain indebted to him for the beautiful series of figures, which illustrate with great clearness the characteristic forms of the sporangia and of the plasmodia in each of the species.

Mr. Lister follows earlier authorities in separating the small group of Mycetozoa in which the spores are not formed inside sporangia from the great majority of forms in which sporangia are formed. We think, however, that he uses the word sporophore unfortunately in his synopsis. The relation between the spores and the sporophore in the Exosporeæ is not different in nature from the relation between the spores and the stalk of the sporangium in those Endosporeæ in which the sporangium is carried upon a stalk. Indeed, the stalk is most usually called a sporophore; the point of difference to be insisted upon is, of course, the existence or non-existence of the sporangium, not the relation of the spores to the sporophore.

OBITUARY.

KARL VOGT.

BORN JULY 5, 1817. DIED MAY 6, 1895.

THE death of Karl Vogt robs science of one of its masters and Switzerland of one of her most devoted friends. Vogt was born at Giessen, and received his schooling in his native town. In 1833 he went to Berne, where he graduated in medicine, taking his doctor's degree. In 1839 he became the collaborator of Louis Agassiz in "l'Histoire naturelle des poissons d'eau douce," and from Neuchâtel went on to Paris, where he lived two years. After a brief visit to Italy, he returned to Giessen, where he held a chair at the University. A too ardent following of the democratic movement cost him his professorship; he had been deputy to the German National Assembly, had supported the National Party, and had gained considerable distinction as an orator. Retiring to Berne and to Nice he pursued his zoological studies, and in 1849 became professor at Geneva, a position he still held at his death. In Switzerland also he closely followed political life, and was a member of both the Federal and National Councils. Vogt's name is associated with anthropology, comparative anatomy, zoology, and geology, each group having been illuminated by his genius. His "Science and Superstition" did much to check religious bigotry, and his exposure of humanity in "Animal Communities" created a considerable sensation throughout the civilised world.

KARL LUDWIG.

BORN OCTOBER 29, 1816. DIED APRIL 24, 1895.

THIS eminent physiologist was born at Wissenhaufen in Hesse. He graduated at Marburg, receiving his doctorate at the University in 1840, and resided successively at Marburg, Zürich and Vienna. In 1861 he was appointed to Leipzig, where he remained till his death. Of his numerous papers and books the best known, perhaps, is his "Lehrbuch der Physiologie." He also edited the annual, *Gesammelte Arbeit des Leipziger Physiologischen Instituts.*

DR. EUGENIO DUGES, the eminent zoologist, died at Morelia, Mexico, on January 13. He was born at Montpellier seventy years ago, and was educated at Melun and Paris. In 1865 he went to Mexico, and practised medicine at Guanajuato, later on proceeding

to Morelia to take charge of the Museum, the College of Anatomy, and the School of Medicine. He published numerous papers on the Coleoptera of Mexico.

HENRY JOHN CARTER, who died May 4, at Budleigh Salterton, was a distinguished medical officer in the Bombay army. He was a voluminous writer on medical and natural history subjects, his chief work being done on the Geology of Western India, and on the Foraminifera and other low Invertebrata.

DR. GEORGE A. REX, the eminent fungologist, died at Philadelphia on February 4. He was the first authority on the Myxomycetes in the United States, and was a cautious and exact botanist, avoiding the establishment of new species until thoroughly convinced that they were really new to science. DR. FRANZ POSEPNY, the well-known geologist, died at Vienna on March 27. He was born in 1836. DR. ALFRED WILHELM STELZNER, professor of geology at Freiburg, died on February 25. WILLIAM PARKER SNOW, so intimately associated with the Franklin expedition, died on March 12, in his seventy-seventh year. He was purser of the "Prince Albert," Lady Franklin's search vessel, and published an account of the voyage in 1851. Six years later he issued a second volume entitled "Two years' cruise off Tierra del Fuego and Patagonia," a record of his work in connection with the Fuegian mission. His one object in life was the rescue of the Franklin expedition, of which he protested, again and again, there might still be survivors.

A portrait of Mr. A. G. More will be found in the *Irish Naturalist* for May.

FROM *Naturae Novitates*, which now comes to hand with greater punctuality, we learn of the death of Dr. EDUARD ROSTAN, an eminent investigator of the Piedmontese Alpine flora, on January 15, at the age of 69. Also of CLAUDIUS REY, the entomologist, in Lyon; and of Dr. ROBERT SACHSSE, Professor of Agricultural Chemistry at Leipzig, which took place on April 26.

SIR GEORGE BUCHANAN, who died on May 5, aged 64, had resigned the post of medical officer to the Local Government Board three years before. All his sanitary work, of such eminently practical importance, was based on thoroughly scientific investigation. Some account of his work and of his honours is contained in *Nature* for May 16.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Dr. A. von Mojsisovics has become Professor of Zoology in the University of Graz; Dr. R. Köhler, Professor of Zoology in the Faculty of Sciences at Lyon; Dr. Eugène Canu, Director of the "Station Aquicole" (Fish and Fisheries) of Boulogne-sur-Mer; Dr. Pechuel-Loesche, Professor of Physiology at the University of Erlangen; Dr. A. N. Berlese, Professor of Botany at the Camerino University; Mr. W. G. P. Ellis, additional Demonstrator in Botany to the University of Cambridge. Professor Dr. K. Weierstrass has been made a member of the Academy of Sciences of Paris in the room of Dr. Kummer. Dr. H. Simroth, of Leipzig, has been appointed Extraordinary Professor. We have the best authority for stating that Dr. Branco, of Tübingen, is to be succeeded neither by G. Steinmann nor by R. Brauns, as has been widely reported, but by Professor E. Koken, of Königsberg. Professor Brauns goes to Giessen.

Dr. Hanitsch has been appointed Curator of the Singapore Museum, thus vacating the post of Demonstrator of Zoology at University College, Liverpool. Professor Oliver Wolcott Gibbs, the well-known chemist, succeeds Professor Marsh as President of the New York Academy of Sciences for the next six years.

The following appointments have recently been made known officially in the Geological Survey:—Alfred Harker and Herbert Kynaston join the Geological Survey of Scotland, replacing the late William Topley and Edward Greenly, retired. Mr. Harker, it is understood, will not relinquish his duties at Cambridge. J. R. Dakyns has been transferred from the Scottish to the English Survey, and this accounts for the two vacancies in Scotland. The Museum of Practical Geology loses its librarian, T. W. Newton. It is now open on Fridays.

Sir William Vernon Harcourt has been elected the new trustee of the British Museum.

On May 29 Mr. William Carruthers, of the Botanical Department, British Museum (Natural History), will bid farewell to his colleagues, and enter upon his non-official life. Mr. Carruthers has been for so long identified with the department that it is difficult to realise that he will still be in the flesh though absent. Mr. George Murray will succeed him as head of the department.

This is but the beginning of a series of changes at the Cromwell Road establishment, the new Treasury minute, with respect to age-limit, acting rather sweepingly at the Museum. We are not at liberty to make known these changes at present, official announcement not yet having been made.

A *Central News* telegram from Brussels states that negotiations have been opened for an International University Extension scheme. It is proposed that some Oxford professors should deliver a series of lectures in Brussels, while some Belgian professors should deliver addresses in Oxford.

The arrangements for the summer meeting of University Extension students at Oxford, which will take place during August, include lectures by Professor Green, Professor Odling, Dr. Kimmins, Dr. Fison, Dr. Wade, Mr. Carus-Wilson, Mr. G. C. Bourne, Mr. J. E. Marsh, and Mr. Percy Groom, accompanied by classes for practical work.

THE Edinburgh Summer Meeting Classes will be held at the Normal School, Johnstone Terrace, Edinburgh, from August 5–31. The courses include all subjects, but those of special interest to our readers are the following:—Applied Physiology of the Nervous System, by Dr. Irvine; The Savage Mind, by Professor Haddon; Biology of the Seasons, by J. Arthur Thompson; Botany Applied to Field and Garden, by R. Turnbull; The Evolution of Cities, by Geddes, Elisée Reclus, and A. J. Henderson; Field Geology, by J. G. Goodchild. Details can be obtained from Dr. R. Stephens, University Hall, Edinburgh.

THE summer plans for University Extension Courses at Toynbee Hall include the following: Darwinism, by H. de Haviland; Primitive Man, by F. W. Rudler; Botany, by G. May; Biology, by Miss Hall; Geology, by Miss Raisin; Physiology, by S. Rowland. The Natural History Society, under the presidency of Dr. J. W. Gregory, still flourishes, ten excursions being arranged for during the present session.

WE have before commended the summer activities of the University of Kansas. The present season will see five different scientific expeditions. Professor Dyche goes to collect and study the birds and mammals of Greenland and adjacent regions; Professor Williston will have two expeditions for the collection of vertebrate fossils, one in Western Kansas and one in Wyoming; Chancellor Snow, it is expected, will spend the summer in the south-west with a party collecting entomological specimens; a fifth party under Professor Haworth will be in the field during the next six months engaged in mapping the Tertiary outcrops of the State. The cost of the three geological expeditions is, we learn from *Science*, borne by special appropriations from the State Legislature.

DR. R. H. TRAQUAIR secured the skin of the Great Auk in summer plumage, which, as the property of Sir Frederick Milner, was bought in at a sale at Stevens' on April 23. The price paid by Dr. Traquair was £350, and the bird becomes the property of the Edinburgh Museum. The Great Auk egg, which was put up at the same time, realised £180. The well-known collection of eggs and nests belonging to Mr. Leopold Field was also dispersed at the beginning of May at Stevens' rooms.

THE Berlin Zoological Gardens have received from Sumatra an orang-utang, locally known as the maroch, and two gibbons from the same place, neither of which have been seen alive in Europe before. They were presented by Dr. Heinrich Dohrn. The orang is the *Simia bicolor* of Geoffrey St. Hilaire, and, although held in reverence by the inhabitants of Sumatra, but little is known as to its habits. The local name of the gibbons is siamang or imban.

THE State of Indiana is making special efforts to conduct a biological survey of the State, the objects being to ascertain the character and extent of the life, to associate workers that they may labour to one end, to stimulate teachers, and to secure for the Academy a representative collection.

THE Geological Society of South Africa has already issued its Rules and Regulations, together with a list of Officers and Council for 1895. The first ordinary meeting of the Society was held in April, when Dr. Exton delivered his presidential address, in which he dealt especially with the "Coal of South Africa." The second meeting was held on May 10, when Mr. David Draper read a paper on "The Primary System of South Africa," with special reference to the conglomerates of the Witwatersrand.

THE German Zoological Society meets at Strassburg from June 4 to 6.

At a meeting of the Victoria Institute on Monday, May 6, there was read a paper by Sir J. W. Dawson, on the physical character and affinities of the Gaunches, or extinct people of the Canary Islands, illustrated by photographs. The author reviewed the historical facts as to the Canary Islands and their inhabitants, the characters of the crania found and the weapons, ornaments, etc., and described the conclusions he had arrived at with reference to the relationship of the Gaunches to ancient peoples of Western Europe and Africa, and their possible connection with the colonisation of Eastern America.

Further particulars of the third International Zoological Congress to be held at Leyden in September are to hand. The sectional meetings will be divided into (1) General Zoology; Geographical Distribution including the fossil faunas; the Theory of Evolution. (2) Classification of living and extinct Vertebrates; Bionomy; Geographical Distribution including fossil Vertebrates. (3) Comparative Anatomy of living and extinct Vertebrates; Embryology. (4) Classification of living and extinct Invertebrate Animals; Bionomy. (5) Entomology. (6) Comparative Anatomy and Embryology of Invertebrate Animals. A long list of zoologists who have promised to attend the Meeting has been published, and those desiring accommodation should apply to Dr. Lidth de Jeude, of Leyden, who will supply information as to hotels, etc.

The subscription list for the International Geographical Congress had, on April 24, reached £2,136. The Royal Geographical Society, therefore, issued a letter on that date pointing out that at least £3,500 would be wanted, and stating that "if the Congress is not the brilliant success which it is expected to be by foreign geographers, the discredit will fall on the Royal Geographical Society." We hope after this gentle squeeze that the foreign geographers will not be disappointed. The anniversary dinner of the Society has been postponed to Tuesday, July 30.

At the February meeting of the Hull Scientific Club a recently-killed specimen of the English Black Rat was exhibited by Mr. J. W. Boult.

M. de Mauroy, of Wassy (Haute-Marne), is preparing an account of all French meteorites or meteoric falls, and will be glad of any communications on the subject.

Mr. Jaroslav Perner, of Prague Museum, has been in London. He is engaged on the Graptolites of the Silurian of Bohemia, in continuation of Barrande's great work. Mr. Perner has also visited Birmingham to see the rich collection of graptolites formed by Professor Lapworth, and we may hope shortly to see the results of his later studies.

With reference to our note last month on Wild Fowl in Norfolk, it should be mentioned that both the Bittern and the Avocet, though not specially mentioned in the recent Order, were included in the Schedule of 1880; and we are informed that protection has been extended to all areas suitable for them to nest in. The birds mentioned by name in the Order were only such species as were too scattered to be protected by the more effective method of naming areas.

We understand that Lord Kelvin is resigning the Presidency of the Royal Society. We sincerely hope that the high scientific reputation of the chair will be considered in the choice of his successor.

At the moment of going to press we are informed that Professor Green has resigned his position on the Council of the Royal Society. Professor Bonney has been mentioned as the probable successor.

CORRESPONDENCE.

BIBLIOGRAPHICAL REFORM AND THE *Zoological Record*.

In "NATURAL SCIENCE, May, 1895, pp. 333-338, there appeared an article with the above title, signed Herbert Haviland Field. From the general tone of the article, and from some of the expressions made use of by Mr. Field, it might be inferred that he is writing on behalf of the *Zoological Record*, and with the sanction of those connected therewith. I, therefore, ask to be allowed to inform your readers that this is not the case, and that the article must not be taken as in any way authorised by those engaged in carrying on the *Record*. The statement in the article as to the annual deficit is quite incorrect.

The existing and long-established *Zoological Record* is superintended by a committee of zoologists appointed by the Council of the Zoological Society of London, to which Society the *Record* belongs. I may, therefore, say, in reference to Mr. Field's phrase about the desire of "zoologists personally connected with the *Record* . . . to raise the standard of the work," that I shall be very much obliged if such persons will communicate with the *Zoological Record* Committee (3 Hanover Square, London), or with myself, as I should much regret that such aspirations should be fruitless.

University Museum of Zoology, Cambridge,
May 7th, 1895.

D. SHARP,
Editor of *Zoological Record*.

[From our editorial communications with Dr. Field, who is now abroad, we are able to say that nothing was further from his intention than any attempt to criticise Dr. Sharp's conduct of the *Record*, or to interpose between the Zoological Society and the *Record*. The statement as to the annual deficit was taken from Dr. Sclater's official letter to the secretary of the Geological Society, published in *Nature* for December 7th, 1893. It is greatly to Dr. Sharp's credit that the deficit has been reduced since. But Dr. Field's general point was that there is an annual loss, and that the Zoological Society, by making use of international co-operation, might be relieved of this financial burden, while the actual conduct of the *Record* would remain in the hands of its committee, and of the present editor.—EDITOR, NATURAL SCIENCE.]

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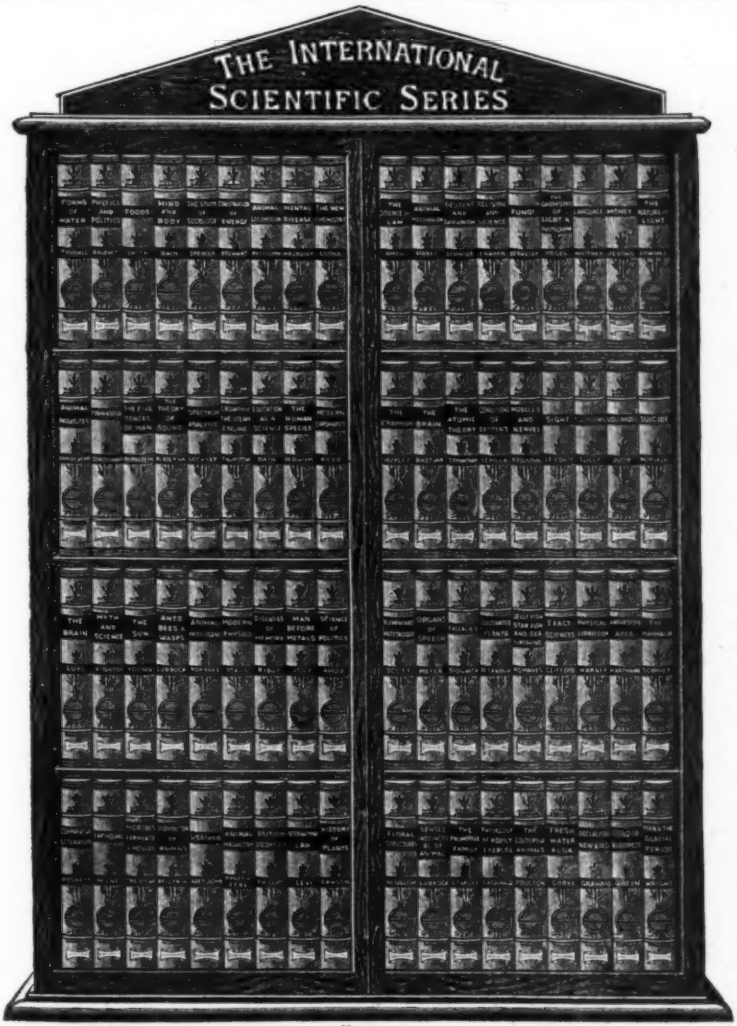

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